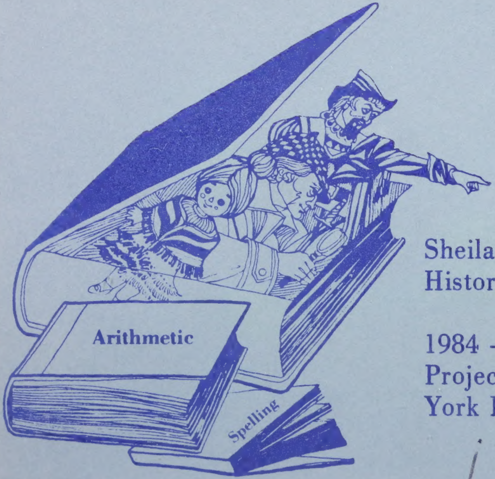

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PRODUCTION RECORDS

How the Factory Keeps Account of the Elements Entering into Production

Being the Fifth Unit
of a Course in Modern
Production Methods

BUSINESS TRAINING CORPORATION
NEW YORK CHICAGO

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Course in Modern Production Methods

JOHN CALDER, Director

With the assistance and cooperation of

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The text of the Course is issued in six units as follows:

I. Team Leadership
II. Handling Men
III. Organization
IV. Handling Equipment
V. Production Records
VI. Management

BUSINESS TRAINING CORPORATION
NEW YORK CHICAGO

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CONTENTS

I. WHY KEEP RECORDS? 1
A Problem for the Foreman—A Call to the Office—An Offer—A Little Look into Earnings—What the Figures Showed—A Problem of Cutting Costs—Records as a Talking Point—Records as a Spur to Production—Memory Cannot Take the Place of Records—Records and Planning.

II. WHAT ARE GOOD PRODUCTION RECORDS? 15
Counting on the Other Fellow's Inefficiency—What the Investigation Revealed—Four Basic Requirements—When Records Were Inadequate—What Records Are Necessary—Confidence Based on Records.

III. MAINTAINING THE EFFICIENCY OF LABOR. 25
Time as an Asset—Two Functions of Labor Records—How Time Affects Productivity—The Check System of Keeping Labor Records—The Recording Clock—Recording the Time Spent—Danger in Leaving Time-recording to Workmen—Using the Job Ticket—Records as Guides to Standardization.

IV. PREVENTING WASTE AND DISHONESTY... 38
Liquid Assets—The Tendency to Waste—The Balance of Stores Sheet—A Perpetual Inventory of Stores—The Requisition, or Stores Issue—How Requisitions Are Handled—Checking Materials—Bins and

Bin Tags—The Use of Symbols—Safeguarding Material through the Plant—How One Manufacturer Discovered a Leakage—Output Should Be Checked against Material—Budgeting the Material—Work in Process—Inspecting the Work—Method of Handling Scrap—The Shipping Ticket.

V. KEEPING TRACK OF FIXED ASSETS....... 64
The Foreman and Fixed Assets—Causes of Depreciation—Investment Ledger System—Depreciation an Operating Expense—Records Should Show Where Equipment Is Located—A Manufacturer's Letter to His Son—When Lack of Equipment Records Was Costly—The Investment Ledger.

VI. MAINTAINING EFFICIENCY OF EQUIPMENT 76
Causes of Machine Idleness—Recording the Output—When the Human Factor Enters In—Records That Stimulate Interest and Cooperation—Increasing the Speed—Knowledge vs. Guesswork—Records of Repairs—The Waste of Idle Machinery—Making the Foreman See It—Guides to Improvement of Design—The Foreman's Own Records of Equipment.

VII. KEEPING PRODUCTION IN STEP 93
How Delay Runs up Costs—Rapid Turnover Is Sought—Some Controlling Authority Is Necessary—The Production Order—Piecework Rate Cards—The Job Instructor—Shop Orders—Keeping Up to Schedule—Using the Schedule Board—How the Board Works—A Picture of Production.

VIII. CONTROLLING THE COST 111
The Cost System Is Built on Basic Records—Detailed Facts Necessary to Control of Costs—Minor Operations May Usually Be Ignored—The Special Order System—Standardized Part System—The Process System—The Systems in Combination—Cost Keeping

Must Pay Its Own Way—Prime Cost—Overhead—Making Each Part of Equipment Bear Its Own Overhead—Labor Method or Machine-Rate Method—The Estimating Cost Plan—Itemized Costs Most Valuable—Timeliness an Essential Feature.

IX. RECORDS AS A TOOL OF PRODUCTION 129
Outbidding Competitors—Letting an Order Take Care of Itself—A Failure of Records—Calling In the Business Doctor—Losses Due to Lack of Records—Records for Their Own Sake—When a Record Was Unnecessary—The Test of Good Records—Records That the Foreman May Keep.

PREFACE

Successful production rests upon accurate and timely knowledge of all the factors that enter into production. No longer is it possible for the man who merely *guesses* that this is so, or *thinks* that that is so, to compete with the man who KNOWS. It is no longer possible or feasible for any one executive—or group of executives—to carry in his head the detailed facts on which production control is based. Therefore recourse is had to written records.

Records constitute one of the most important tools of modern industry, useful alike to the worker in the ranks, the foreman who directs the work, and the higher management who are responsible for final results. Each industry may have its own detailed record systems arranged to facilitate and make certain the proper control of its operations, but there are fundamental principles on which all good records must rest, and there are applications of the principles to plant needs that have become almost universal. The purpose of this Unit is to make clear these principles and their application as they are exemplified in modern industry.

I

Why Keep Records?

BIG Bill Wright, foreman in a Western automobile factory, was worried. One of his best men had been laying down on the job, and Big Bill knew it. What's more, the offense was not a matter of a few days or weeks, but a long record of months of lagging work on the part of the time-wasting employee.

A Problem for the Foreman

Big Bill had borne with Sam Pitkin because he knew that Pitkin was really a skilled and capable mechanic. Men of his aptitude and experience could not be picked up every day, and so the foreman had suffered Pitkin's shortcomings in silence, respectful of his quick temper and hopeful that his sense of fair play would wake him up before it was too late. But now the situation was getting dangerously near that extreme. Pitkin had become a bad example to the other men, as well as a time waster. Just how to handle the case worried Big Bill. He had to do something. He didn't want to lose a worthwhile man. He didn't want to keep a loafer on his payroll. How to do the one without doing the other—that was his problem.

The foreman picked up a sheaf of card records that lay on his desk. He had spent some time going over these cards that morning, and knew them almost by heart. Glancing at them now, a new idea suggested itself, and as he revolved the thought in his mind, his face broke into a broad grin. "By George," he exclaimed under his breath, "it's worth trying!" He opened a drawer of his desk, took out a roll of blueprints, and laid them on the desk with the other records. "Yes, sir," murmured Big Bill to himself, "it might work. I'm going to risk it."

A few moments later the foreman could be seen making his usual trip of inspection through his department, stopping here and there to inquire of some piece of work under way, answering the men's questions, throwing in an occasional cheery remark, and in general making his presence felt. Big Bill was a true leader, an adept at handling men, and of all the foremen in that factory the one most popular with the men.

When he came to Sam Pitkin's machine, Sam looked up sheepishly. "How's things, Pitkin?" inquired the foreman. "Oh, just fair," answered Sam. "This keyseat's been taking most of the day, but it's almost finished now." The foreman looked at it. "Yes?" he answered. "Well, when you are through with it, Pitkin, I wish you'd step into my office for a few minutes."

A Call to the Office

Later, when Pitkin walked the short distance from his machine to the partitioned-off corner where Big Bill had his office, some of the men openly snickered. They knew what was coming. So did Sam—or thought he did.

Big Bill was seated at his desk, and looked up pleasantly as Pitkin entered. "Have a seat, Sam," he invited, "and take a look at these," he added, handing over the roll of blueprints. Sam recognized them at once.

"Why, that's the new machine!" he exclaimed, wondering why Big Bill had chosen this way of introducing a disagreeable subject.

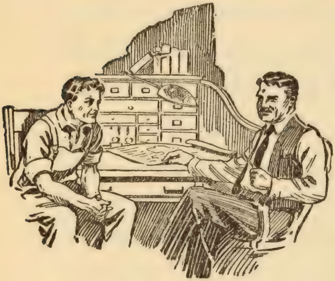
An Offer

"Yep—isn't she a beauty?" returned the foreman, and then, before Sam could reply, "I'm going to turn her over to you, Sam—give you the chance to make her prove herself. Think you'd like to tackle it?"

Sam was too astonished for words. He finally managed to say, "Why, yes, Mr. Wright, of course—but I thought——"

"I know what you thought, Sam," interrupted Wright. "You thought you'd be the last man in the shop to get a chance at that machine. And you thought—didn't you?—that I called you in here to fire you."

Sam's face reddened. Then he answered. "Yes. And I've felt for some time that I wasn't wanted around here. I think I'm too independent for this grind of being a little cog in a big machine, and getting squeezed harder every day by my landlord and the grocer as well as by the works."


"I'm getting squeezed harder every day," said Sam.

"Sam," answered the foreman, quietly, "the reason it's a hard pull for you is because you're not doing yourself justice. The piecerate in this plant is as high as you'll find anywhere and will give an experienced man like you a good living if he does his part."

A Little Look into Earnings

Wright turned to his desk. "Your earnings have fallen off, Sam, and that's what I wanted to talk to you about. You and I were taken on here at about the same time, three years ago. You had just started as oiler when I came over from the Blackstone shop to take charge of this department. You were put on as a machinist a year later. Your first year's record was a good one. So was the next year's. But then you began to slip. It was only a little at first, but as the months went by, you slowed up more and more. Naturally, your income has grown smaller week by week; no wonder you complain about being squeezed harder all the time by the landlord and the grocer."

Sam smiled grimly, and wondered just what Big Bill was leading up to.

"I've been doing a little figuring," continued the foreman, "and I thought you'd like to see the result. If you had worked about as hard last week, Sam, as you did the first week you went on as a machinist, your wages would have been 56 per cent higher than the amount you took home Saturday. Our piecerate has advanced slightly since you began, and the improvements in machines and handling methods have increased average output fully 10 per cent, as our records prove. Here I've got it figured out in dollars and cents." Big Bill handed over a sheet of paper on which he had totaled entries from the cards. Sam bent over it, surprised and interested. After he had studied the figures a few moments he looked up.

"Do you keep such records of what every fellow does?" he asked.

"Sure I do," answered the foreman, pointing to a row of filing cabinets. "When the cost department finish with your job tickets, they send them here. They also send a record of your production in money value and in pieces.

What the Figures Showed

I've got the figures for every man in the department. I don't have to be out there in the shop to see that a fellow is falling down on his production; these figures show me. The records show other things too. For example, Sam, here's another little tabulation that will interest you." He picked up another card. "During this last year, while your earnings have been going down because of your slower production, you have been late a hundred and four days. Oh, it was only four or five minutes each time. Not worth kicking about, you might say, but multiply it by one hundred and four and it mounts up. It isn't our piecerates that are to blame, Sam. It's you that failed to use your time to make the most of them."

"I guess you were kidding me about that new machine," said Sam, crestfallen, now that he had been made to see himself as others saw him. "You'd hardly trust it to me, after all my soldiering."

"No, Sam. You've got me wrong. I meant exactly what I said. You get the machine if you want it. Only, I thought you ought to have the benefit of these records here, and see just where and why you have been losing out. Every man in my department stands on his own feet. He's an individual. He's paid for what he produces. That's square to every worker and to the company, because the company gets its money to pay us all from what we produce. If we produce less, there is less to pay for, and less to pay with. I play no favorites. Why do you suppose we have different rates for different pieces? Because we've studied these jobs, and know how much time each piece ought to take a good man to turn out.

A Problem of Cutting Costs

"Our present rates are about as fair as they can be made under present conditions. They give a good income to men who work conscientiously, and at the same time are not so high as to run up production costs to a point where plant profits, on which we all depend for a living, would be threatened. The policy of this company is to make production savings by improving methods rather than by lowering wages. We have been searching for ways to reduce manufacturing costs. That new machine represents one of the ways. If by high-speed machinery and new methods we can cut production expense it may be possible to increase wages. At any rate, that is the only way we *can* expect to get more money, for as you know, we're bucking strong competition and our profits have been cut to the bone from the start. I believe that improved machinery and better methods will enable us to produce enough per man to make considerable savings. And I want you to help me prove this. I've got no sentiment in the matter. I remember that a while ago you were the best machinist in this department. I want you on this machine, because I believe you can make it do what I'm expecting of it. Can I count on you, Sam? And remember—we don't guess about results. We have our records, and we know. We can't go wrong if you make good."

Sam did make good, and reestablished himself in his old place among the machinists. Somebody, reading this incident in the manuscript, remarked that it was a fine example of handling men, and would go well in Unit II. It is a fine example of handling men—and you will recall a somewhat similar incident in Unit II—but it is also a conspicuous example of handling records. Big Bill's success in this case was due to the fact that he had the records. Those records not only proved the case to Sam, but they guided the foreman in his handling of Sam and of the whole problem of increasing production. He didn't have to guess. As he said, *"We have the records, and we know."*

If you ask Big Bill Wright "why keep records?" he will point to Sam Pitkin, expert machinist, as a concrete answer. "If I hadn't known exactly what Sam had done in previous months, I could never have been sure of my facts as to his ability and earning power. And if I had not been able to point him to the facts, to quote exact figures, Sam would never have been convinced. It was my records that helped me to turn Sam Pitkin from a slacker into a real worker and the top-notch man in my department."

Records as a Talking Point

But Big Bill's confidence in records does not rest on this one example. Over and over again in his twelve years' experience as a foreman, he has been helped out of many a difficulty by going to his records and consulting them. By showing what has been done in the past, they have guided him to the right method of meeting a new problem. By means of records, he has checked up not only the efficiency of his men, but also that of his equipment. They have aided him in detecting wastes and in stopping the leaks that were cutting down his departmental production and running up costs. Also, by means of records he has found that the instincts of workers can frequently be appealed to effectively, and better teamwork promoted.

An example of the latter result is contained in a little experience that Wright had as foreman of the finishing room of a factory making a certain electrical specialty. One of the functions of the finishing department was to apply a coat of lacquer to the article by the spraying method. Several men were engaged at this work and when Wright took charge of the department, most of them were plodding along in a slipshod way, without much interest in their jobs, and careless of material. The new foreman began to keep tabs on the requisitions for lacquer issued to the men, and he found that the number of pieces sprayed per gallon varied widely. Whereas one man was turning in 1600 pieces of finished product per gallon, another was finishing only 1200 with the same amount. Examination showed that the larger production was better done—the finish was smoother and more even than that of the other batches of product.

Of course the men did not know this. They kept no count of the gallons of material issued, and had no interest in checking up on work that to them was simply a monotonous grind. Big Bill Wright decided that one of the reasons for their lack of interest was this very ignorance. He reasoned that if he could inform them tactfully of the amounts of lacquer used, the effect would be to awaken their interest in the work and at the same time stimulate them to avoid waste and strive for higher production.

Records as a Spur to Production

What did he do? He announced that the department was going to run a race with itself. Beginning the following Monday morning, he said, there would be posted on the bulletin by the door a record of the previous week's highest production. The name of the man who finished the largest number of pieces per gallon would be entered, together with his record. This record would stand until somebody beat it, and then the new winner's record would go up.

The competition that resulted was a revelation of what men can do when their interest is stimulated and they work under the guidance of facts instead of guesswork. The low man not only came up to Jones's high record of 1600 pieces per gallon, but Jones soon passed his old record. In less than one month, the average rate of finishing had been increased to 2600 pieces per gallon. Then the men, under the leadership of their foreman, began to study the little kinks and problems involved in the handling of the lacquer, in the manipulation of the spray, the holding of the article to be sprayed, and other details. The result was that soon many wasted motions were cut out, and the output was not only increased per gallon of lacquer but also the output per man per hour. At the end of three months, the efficiency of the finishing department had been raised fully 100 per cent, thanks to the common-sense use of records.

Memory Cannot Take the Place of Records

Here and there in industry you will find a man proud of his fine memory. He will tell you that he doesn't have to spend his time making notes, and filling in cards. His memory is perfect, and he can trust it in any emergency. This may be true—in some cases. There are examples of men with unusual memories, and a good memory is a valuable asset for a man to have in any enterprise. But a good memory shouldn't be overtaxed with details. Records are necessary to reinforce the memory, to take care of the details of figures, dates, plans, schedules. By the use of records the memory is freed of a great mass of routine, and enabled to occupy itself with matters which card catalogs and files cannot care for. Moreover, a good memory is a personal possession, and should the man who owns it die or quit, the mass of data which he carries in his head would depart with him.

Some years ago a concern which manufactures metal novelties had its plating and metal-finishing department in charge of a chemist who was something of an inventor. Through a series of experiments this man developed a chemical process which gave the product a beautiful and distinctive color. In its advertising the company featured this exclusive quality of its product and built up a considerable reputation for it. In time the chemist resigned and left the country, and when his successor attempted to plate the product it was found that he was unable to duplicate the chemical solution which gave the distinctive coloring. None of the men in the department seemed to know the exact formula used, and it took a month of experimenting on the part of the new chemist to hit upon the exact combination desired. During this waiting time production was curtailed, to the great loss of the employees as well as the owner of the business.

The discoverer of the process of course had the formula "in his head." Perhaps he had a written notation of it among his papers. But the company had failed to provide a system for recording and filing such data, and as a result the new chemist had to make the discovery all over again. Work had to be done twice, not to speak of the loss resulting from the interrupted production, simply because of the lack of a written record.

Records are necessary to the planning of a job. It is on the basis of what men have previously done with a certain machine or a certain tool, operating upon certain material, that the management is able to schedule work. Were no records kept of past work, it would be impossible to schedule future work with any degree of efficiency. Here it is fatal to trust to the memory of the foreman or other shop executive. There may be here and there a mental prodigy who can remember exactly what output per hour should be made at each machine, who knows to a dot what Jones can do in a given job, and what Smith can do. But these exceptional men are not available in every factory; and moreover their memories (like that of the chemist) may depart with them any day. The only safe way, the only right way, the only business way, is to keep careful records of all elements that enter into production and of all factors that affect the movement of material from its raw state to the finished product.

Records and Planning

What these records are and how they should be used by the production executive is the subject-matter of this Unit. It will distinguish between a good record and a bad record, just as between a good tool and a bad tool, and it will show you what kinds of records are necessary, how to keep them, and finally how to use them as aids to efficiency.

II

What Are Good Production Records?

THERE are good records and bad records, and good systems and bad systems of keeping records.

Counting on the Other Fellow's Inefficiency

Several years ago a New York concern found itself unable to market its product at a profit and meet the prices of a large competitor. The managers of the concern figured that the competitor was selling at a loss, and they were confident that this loss would soon force it either to increase prices or to get out of that line. Their own concern was large, its production was carried on through twenty operating departments, and as they had a very elaborate cost-finding system they knew that the competitor's prices were below their own costs. Here was another case of the manufacturer not knowing his costs, they thought; and smilingly they sat back to await the crash.

But the months passed on, the end of the year came, and still there was no crash. In fact, the competitor seemed to be prospering, for it added a new wing to its factory building and made a large increase in its working force. Then the managers of the other concern decided to look into their own affairs more closely, instead of assuming that they were right and their rival wrong. What they discovered after a little patient analysis of their system of cost records was enough to turn the management pale with shame at its own carelessness and assumed superiority. The more glaring faults of the many that were uncovered by this investigation are listed in the following items:

What the Investigation Revealed

1. Each department employed two clerks to keep time and other records of operatives. In the central cost department eight clerks were doing over again the work done by the forty department clerks. This duplication was expensive.
2. Records entered twice were sometimes entered wrongly, showing up as double their correct amounts. This was particularly true of materials records, so that the apparent cost of materials was sometimes twice what it should be. In addition, the elaborate system provided no check against waste of materials.
3. The system was so elaborate that it was normally from two to three months before the cost of any week's production was known; and then it was too late to effect economies, because

the plant had been turned to the production of other articles.

4. None of the foremen or workers understood the system, so all looked upon it with suspicion, and records kept by the foremen and workers were slipshod and inaccurate.

As a result of this inquiry, the system was given a complete overhauling. The forty clerks who had been keeping time in the departments were eliminated, and foremen and workers instructed in the value of keeping simple records. This effected a saving in manufacturing costs. Records were analyzed weekly so that the information gained from them could be used to prevent waste and cut costs. A check-up on waste was made possible with the new simplified records, and their greater accuracy showed that the company could meet its competitor's price and still make a good profit by making use of the information the records supplied and which had formerly been stored in files and elaborate reports not understood by anyone but the chief accountant.

The evils of inadequate records and too elaborate a system were common a few years ago. Either a plant had no worthwhile records at all or was apt to have a too elaborate system, and of the two evils, the latter is the greater. Records cost money. Unless they facilitate the operation of the business, they are a dead expense. Records for their own sake are valueless. They must measure up in every case to the test of utility, aiding production or saving expense, in order to qualify as good records.

Four Basic Requirements

Right at the start we ought to recognize that there is no mystery about records. While a good system can hardly be installed without careful thinking and expert knowledge, it is quite possible for any sensible production man to form a judgment as to whether any given record is well-suited to its purpose or not. There are just four fundamental principles to be observed in planning and installing any system of records, and they are the measure of its practical value. Any record that fulfils these requirements is a good record. Any that fails to measure up to any one, is a bad record. Good records should be:

1. Accurate
2. Timely
3. Simple
4. Adequate.

Unless records are ACCURATE, they are not only a waste of time but they may also cause other losses by misguiding production executives. The foreman of the press room in a good-sized printing plant was asked why one of the presses which worked exclusively on the printing of a periodical did not make better speed. The records showed a production of 500 impressions per hour for each press. The presses were easily capable of 1000 per hour. Investigation showed that the presses were idle half the time and that the cost system had failed to record this fact but had charged up all the time (idle and productive) to the periodical. By a little extra sales effort another periodical was secured with a publication date that enabled the presses to be used continually on productive work.

TIMELINESS is also essential. The manufacturer wants to know the standing of work in his production departments this week—so that he may plan operations for next week. He wants to know the cost of production now, so that he may regulate his prices in time to benefit by the knowledge. He wants to know the moment a new order for material must be placed.

The more complex and involved a record is, the greater the expense of it. Complicated records cost time in the making of them, and they also call for an unusual amount of effort and mental concentration on the part of the person consulting them. SIMPLICITY is almost as essential as accuracy. And this applies not only to the record itself, but to the method of filing. Where symbols are used they should be such as can readily be remembered.

Finally, the records must be ADEQUATE. That is to say, they must give all necessary information. This does not mean that everything about the subject must be down on the record card. It does mean that no important question be left unanswered. Abbreviations may be freely used, provided their meaning is clear. It is quite possible, as succeeding chapters will show, for a record to be both brief and adequate.

When Records Were Inadequate

A certain stove manufacturer in Pennsylvania had an experience which exemplifies what may happen if the records are inadequate. Four models of stoves were manufactured in his factory. The selling price of each was fixed on the basis of estimated costs, and the manufacturer depended on the financial statements which he received from his accounting department to show whether or not he was making money. Month after month these statements showed a slightly declining profit, but increasing sales. This was rather disturbing. It seemed reasonable to the manufacturer to expect an increase in profit as his sales increased. He had an expert investigation made, and it showed that while he was making money on three stoves, he was losing money on the fourth model. Moreover, this fourth model, because of its cheap price, was selling in large quantities, thereby increasing the total of sales. Naturally, the more this fourth model sold, the less the monthly profits. Had the monthly statement submitted by the accounting department been itemized to show returns on each model separately, the manufacturer would have seen the situation immediately and taken steps to remedy it.

Statistical and Financial Records

Business records, in general, are of two kinds: (1) financial and (2) statistical. The financial records are the records of the buying and selling transactions of the company and records of its resources, liabilities, profit and loss. These are the records with which the bookkeeper and accountant have to do. They concern the practical production man only indirectly. The statistical records, on the other hand, are those that keep tabs on the various factors that enter into production. They are of direct interest and value to the production man. They aid him in eliminating waste, guiding production toward the goal of 100 per cent output, controlling costs. Without statistical records, the manager would have to guess at the line-up of work in the plant, and the foreman's memory would be his only guide as to what jobs were to be done in his department, how they were to be turned out, what materials were to be used, and when they were to be completed. Certain statistical records are absolutely necessary to economy and smoothness of production.

What Records Are Necessary

The way to determine what records are necessary is to analyze the functions of the business and note what records are needed to keep performance of the functions up to the highest level. There is one function that is universal to all business. It is the function of earning money for its owners—of making a profit. The factory makes a profit by producing goods which will sell at a price greater than the cost of production. It is clear that whatever tends to reduce the cost of production is an advantage to the factory. If its production costs are lowered, it can either earn a larger profit on each finished product it sells, or it can cut its price and so win customers from its competitors and thus earn a larger profit by producing and selling a larger output. Necessary records are those which assist the factory to cut down wastage and eliminate weaknesses, thus enabling it to produce its goods at the lowest possible cost and to fix its selling price with knowledge, instead of by guesswork.

Such records should be efficient aids to the production man in:

1. Maintaining the efficiency of labor.
2. Preventing waste and dishonesty.
3. Keeping track of fixed assets.
4. Maintaining the efficiency of mechanical equipment.
5. Keeping production in step.
6. Controlling costs.

Confidence Based on Records

When a plant has a system of records which keeps its management accurately informed on these matters, production can be carried forward with confidence. Such a plant is able to give customers definite promises of delivery, for its work moves along according to schedule and it knows just what it can do. It can bid on a contract or name a price without guessing, for it knows its costs. It can take advantage of favorable market conditions to stock its stores room; it can distribute its orders so as to make operations more uniform, and therefore give steady employment to labor; it can keep its plant "up to scratch" and its capital investment unimpaired. Its foremen and other industrial executives find their work moving ahead more smoothly and with less fuss and waste, because their operations are not dependent on mere memory or haphazard guesswork, but are guided at every step by the known facts as plainly shown in the records.

One important group of factory records not touched upon in this Unit is the system of personnel or employment records. They have been treated in detail in Unit III, and repetition here is unnecessary; but it should be borne in mind throughout how important a factor in plant efficiency the personnel records are. They aid the management directly in fitting men into the work for which the men are best adapted, not to speak of their assistance in reducing labor turnover.

Good operation and good management are so much a matter of having and following correct records, that the modern factory recognizes the function of record keeping as an essential element in successful production work. Business records are no longer the exclusive concern of some routine bookkeeper or specialized bookkeeping department, but are vital in the shop office and in the operating departments as well as in the executive offices. The following chapters will treat of the various kinds of records that aid the production executive efficiently in the performance of the six functions enumerated.

III

Maintaining Efficiency of Labor

TIME is an asset just as truly as a piece of machinery or a carload of coal or a barrel of lubricating oil is an asset. Only by handling efficiently our time, and the time of those under our supervision, can we make the best use of equipment, material, and supplies, and really turn out goods efficiently. In fact, the greatest item of cost in most manufactured goods is labor. There is nothing that can run up production costs so rapidly as the slothful worker.

Time as an Asset

When a foreman or other industrial executive employs a worker or a group of workers, he is buying an asset that can be realized on only by making good use of the work-time thus purchased. Of course he has not bought the employee; what he has bought is the man's time. Just as money may be wasted in buying poor raw material, or in careless handling of the material after it is bought, so a great deal of money can be lost through failure to handle this valuable asset, time, efficiently. There is certainly no more necessary function in modern industry than that of maintaining the efficiency of labor.

The maintaining of labor efficiency begins in the employment office, with the selection of applicants for jobs. But we take it for granted that adequate employment records have been accepted and installed, and shall consider in this chapter only the records that deal with the use of labor after it has been procured.

Labor records must perform two functions: (1) record *time spent,* and (2) record *work performed.* Of every worker's day or job, the production executive wants to know these two things: (1) How much *time* was spent on the work. (2) How much *output* was actually produced within the time.

Two Functions of Labor Records

Time is a factor of first importance in labor records, though in some plants where piece-rate systems are the rule this is not fully recognized. Whether a worker is being paid by the hour or by the piece all wage records must eventually be translated into time records. This is true because the plant in which the worker works, the machinery and other equipment that he uses, are all items that enter into production costs, and there is no simple way of keeping track of such expenses other than a record of them by the hour. Therefore, the last analysis of labor cost is always a record of hours. Usually it is a record of "one-man hours"—that is, the total number of hours spent by all workers lumped together as though one man had labored all these hours in a given period, say a week or a month.

The hour is chosen as the unit because there is no such thing as a standard working day. And where overtime is paid, it is a simple matter to multiply the overtime hours by 1½ or 2 (or whatever the overtime rate is) and thus reduce all hours to a standard for comparison. This is in accordance with the fundamental rule that records be simple.

How Time Affects Productivity

Time affects productivity and profits, and, therefore, the ability of the manufacturer to pay wages. Unless hours for starting work are observed, the factory is suffering a money loss as real as when material is spoiled or lubricating oil spilled on the floor. Five minutes late in the morning may not seem serious. But suppose five hundred employees are five minutes late, the time lost is equivalent to an entire week of worktime of one man. In addition to the waste of wages, there is idle machinery occupying floor space on which taxes or rent is paid and representing a money investment on which interest is paid; the power is on, from which no benefit is derived; overhead expenses of various kinds are going ahead, and production is temporarily suspended. Moreover, one man's tardiness often delays the work of an entire gang. In a copper-rolling mill, if two men are late five minutes the rest of the crew of twenty-five men have to stand around waiting for them, and the total time lost is twenty-five times five minutes, which is more than two hours. If every man could realize that the time he wastes is cutting down his industrial efficiency and wage-earning capacity, there would be less indifference to the value of five minutes.

Moreover, without stated times for beginning and ending work, there can be no effective planning, no control of production, no teamwork.

Since the time element is so important, some system of keeping account of the arrival and departure of employees is necessary. Perhaps the oldest of these systems is that which makes use of the TIME CHECK. This system is variously applied. In one factory, the workman is given a brass check as he enters the plant in the morning; and on reaching his department he hooks the check on a board opposite his name. In another plant, the board is placed on the entrance, and the employee takes his numbered check from

The Check System of Keeping Labor Records

the board as he enters. When the signal for starting work is given the timekeeper notes which checks are still on the board, and records the absences. During working hours each employee keeps his check, hanging it on the board as he passes out at quitting time. Thus, the presence of a check on the board indicates that the workman identified with that check is out. By consulting the checkboard at any time, the timekeeper or foreman can tell who is absent.

Another primitive system dispenses with checks altogether. As the workmen enter the plant, each man calls his number or name, and the timekeeper keeps tabs on his list. For those tardy, the time of arrival is noted. It is then easy to see by the blanks who are absent.

While these systems have proved fairly satisfactory in small plants, they are subject to various criticisms. Checks are easily lost or misplaced. Timekeepers are but human, and may occasionally make an error in entering a record. Even the most careful will sometimes be accused by a disgruntled offender of "making mistakes." A system that will automatically and mechanically make a record of arrivals and departures puts an end at once to all such controversies, and at the same time considerably reduces the expense of timekeeping.

The Recording Clock

Such a system is provided by the TIME-RECORDING CLOCKS which have come into wide use within the past few years. They vary in details of operation. Some record the time upon a tape within the clock. Others print the time upon a card. But with all types, each employee records his own time as he enters or leaves. There can be no dispute or difference of opinion as to the accuracy of the record, since it agrees with the time which he reads upon the face of the clock as he registers. Moreover, the record is typed upon the card or tape, and is more legible than the average handwriting.

The correct place for the recording clock is within or directly at the entrance to the operating departments—not at the entrance to the plant which may be a full three or five minutes distant from the actual manufacturing. The machinery starts at the opening hour, and the on-time workman should be at his place at that hour, not just ringing in at a clock six hundred feet away.

The clock or tape is, however, a limited record. It tells absences and tardiness, and the number of hours spent within the plant;

but it does not show how much of this time is spent in actual work.

It is important for many reasons that the factory management have an account of how its workmen use their work-time. It is important to know how much of the time spent within the factory is really productive.

Recording the Time Spent

Various schemes have been used to keep tabs on time within the operating departments. In some, the workman simply tells the timekeeper how long the job has required, and the timekeeper notes this oral report on his time sheet. In other systems the workman makes out a written report at the end of the day or upon completion of the job. Such methods leave too much to the memory, and recording the use of time after the work has been completed is too often a matter of guesswork. Where the workman himself is left to fill out his time slips, there is a natural temptation to make as good a showing as possible. If some of the jobs take longer than conditions seem to warrant, there is the temptation to balance the time more evenly among the various jobs. This defeats one of the main purposes of the records—namely, to ascertain the labor cost of each unit of production.

Such a practise, moreover, works to the injury of the worker himself. Suppose, for example, a certain reaming operation required more time than the worker thought it should, whereas other reaming, because of the simplicity of the operation, was done in exceptionally good time. By "fixing" his work reports so that the simple operation was shown to have required slightly more time than it actually did, and the difficult operation slightly less, the workman might seem to make a better showing. But if later he were assigned a big job of the difficult reaming to do, and were expected to finish it on the basis of the record he had previously reported, you can see where he would come out. There would now be no chance to even up a lean job by borrowing from a fat one, because in this case the whole job would be lean. Absolute honesty in making records is essential to efficiency.

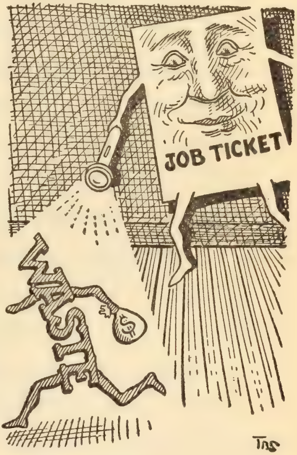
Danger in Leaving Time-recording to the Workman

The way to safeguard the accuracy of time records is to take the responsibility for recording them out of the hands of the operatives. This is no reflection on the workman, but is simply an application of the principle of specialization. Relieved of responsibility for keeping tally on his time, the workman can concentrate on his job and thus make the fullest use of his time. Moreover, one central authority in the department or work room is held accountable for the accuracy of all time records, and this fixing of responsibility is a further gain in efficiency.

Using the Job Ticket

The job-ticket system is used by many modern plants in recording work time. For each job assigned to a workman, a JOB TICKET is made out by the foreman, or by a clerk in the shop office, indicating the nature of the operations to be performed, material to be used, and giving other instructions. When the work is given out, the time is stamped on this ticket; and when the work is returned completed, the return time is similarly stamped. Thus, the job ticket shows on its face an exact record of when the work was started and when it was completed, and the calculation of time spent is a simple matter.

One waste which exact time records tend to eliminate is lost time between jobs. The job ticket shows up in unmistakable figures when the work was issued and when it was returned, and there is no chance of concealing idle moments between jobs.



The Job Ticket shows up Waste.

In one plant of considerable size, the men themselves called attention to time waste which was hurting both employer and employee. The workmen were required to call at the stores room for material and secure tools from the tool room, as well as return finished stock and tools at the completion of the job. It was not unusual to see half a dozen men awaiting their turn at the store room. The shop was operated on a piecerate basis, and there were many complaints from the workmen who chafed under this idleness and the curtailed earnings which it involved.

If you pass through that plant today you will find a new system in operation. The men are at their machines. You will notice at convenient positions throughout the shop boxes with transparent sides of glass so that the contents are readily visible. Beside each box is a check board marked "Work-Wanted Cards." On the board are hooks bearing cards upon which are the check numbers and names of the operators in that section. When a workman gets within fifteen minutes of the completion of his job he takes his card from the board and drops it in the box, returning immediately to his machine. A floor messenger who is constantly on the lookout for such cards, sees it in the transparent box, takes it out and delivers it to the foreman. That card tells the foreman that the workman whose name and number are stamped thereon will finish his job within fifteen minutes. So he assigns him a new job. The clerk makes out a job ticket, sending it to the stores room where the necessary material is made ready and the necessary tools issued. All are delivered by messenger to the operator, usually reaching him a few minutes before the old job is finished. As soon as the old job has been taken away, the work-wanted card is replaced on the board.

This scheme has proved wonderfully successful. It has increased production by permitting the producer to stick to his machine. As a refinement upon the original idea, floor wagons fitted with shelves are now used by the messenger to deliver the new work and return the old. With these wagons it is possible to carry as many as a dozen jobs in either direction. One wagon serves seventy-five men.

Complaints are no longer heard. Production has been increased. The interests of both employer and employee have been bettered. Incidentally it was one of the workmen who thought of this scheme and suggested it to his foreman—with results as described. That workman was generously rewarded by the company for his alertness and clear thinking.

Such records as the job ticket perform the second function of good labor records—namely, keep track of output. We shall see in a later chapter how they enable us to control labor costs. They have a third valuable function to perform—and that is to guide in the making of wage or piecerate scales and in maintaining differentials between jobs, workers, industries, and industrial centers. They can serve as such a guide, of course, only when intelligently used by the production executive.

Records as Guides to Standardization

It is important to both employer and employee that standards of labor productivity be known. To the employer it is important, because it enables him to control labor costs. To the employee it is important because it enables him to prove his superiority over an inefficient or less-skilled worker. Moreover, these records which show in accurate figures a man's output give him a sense of his own importance and value in industry. One of the few disadvantages of industrial teamwork is the fact that where the team is large, the individual is often lost sight of, he merges into the mass, and loses his sense of personal achievement. By means of work records each man is lifted above the mass, and is shown a picture of what he has accomplished, what he has failed to accomplish, and of how he stands in comparison with the other men.

The great need is better use of labor records.

Many concerns have excellent time-recording and job-recording systems, but make little use of them. Some of these concerns never realize the opportunity that these records give them to take their workers into their confidence and stimulate a greater teamwork. When the workers understand that wages, piecerates, differentials, time-requirements, and other conditions of their employment are not determined by whim or favoritism or a desire to "drive" them, but by records that are backed by reason, then the efficiency that comes from willing work will be mightily encouraged. In fact, such records are the chief tool of the industrial executive as he faces the problems of the future.

IV

Preventing Waste and Dishonesty

IN addition to his time, the industrial assets with which the worker deals most intimately are the materials, supplies, and tools intrusted to him in the course of his work. These represent a considerable money value to the factory, and it can be readily seen that their waste or loss through any cause may be a serious drain on the resources of the plant, and a handicap to its efficiency.

Liquid Assets

Materials, supplies, and tools are commonly classified as "liquid" assets, to distinguish them from the so-called "fixed" assets—the plant and its equipment. The liquid assets are also sometimes called the "going" or "current" assets, because they are constantly being used up in the process of production. They are literally flowing from one form and condition to another, as the work progresses through the factory.

The first records of liquid assets are those that affect and control their purchase. Efficient purchasing is dependent on a correct requisition system, in which the responsible production men fully and accurately and in good time indicate their prospective requirements of materials, supplies, and tools. But beyond this, the production man has little to do with purchasing records, so we shall not undertake to go into them here.

The best modern practise is to require that all goods purchased go first to the stores department, even when the requisition calls for delivery to a certain foreman or workman. This is done in order that proper records may be made, both of the receipt of the article and of its entry into the processes of manufacture. It is naturally an advantage to have all issuance of material, supplies, and tools centralized in a responsible stores department.

Here, as everywhere else in industry, records are an essential element in maintaining plant efficiency, safeguarding the assets against carelessness, extravagance, and pilferage, and properly accounting in the cost-finding system for all material, supplies, and tools.

The Tendency to Waste

It is remarkable how lightly the average man in industry regards the value of material. The same person who will take pains to pick up a copper cent from the floor and hand it back to the man who dropped it, will carelessly mutilate or destroy a piece of copper worth many times the value of the coin. In most cases, there is no thought of dishonesty in the mind of the man who wastes material; it is simply that he does not realize that material represents so much actual money belonging to the plant. The average production man sees materials of many kinds all about him in the plant. He works with certain materials every day; it is easy for him to get as much of them as he needs for his job. His familiarity with these materials, and his freedom to use them, make him forget their value. He will often handle them carelessly, misuse them, and waste them in various other ways.

Only by installing proper records and insisting strictly on their use, can the modern factory overcome this almost universal tendency of human nature.

The Balance of Stores Sheet

Usually the simplest method of keeping track of stores is that which uses a BALANCE OF STORES SHEET, sometimes called the "going" inventory. It is simply a perpetual inventory of all assets for which the storekeeper is responsible. By its system of maximum and minimum control it shows when stock is getting low, and so shows the stores department when to draw requisitions for new stock.

By means of this record, provided of course that the entries are properly made and checked, it is possible to tell at any time the inventory value of materials. All that is necessary is to draw off the balances from the various card or loose-leaf records and total them.

A separate sheet may be used for each material carried in stock. At the top of the sheet is noted the minimum amount of material to be kept available for use. When the quantity falls to this minimum it is time to issue a requisition for more, the amount required being shown at the top of the sheet. When the requisition is written, the amount and date are entered in columns under the heading "stores ordered, but not yet delivered." When information is received from the purchasing department that the material has been ordered, the purchase order number and date set for delivery are also recorded. The date and quantity ordered are then entered in the column under the heading "stores available." When the purchase arrives, new entries are made. The quantity received is deducted from the total in the column "stores ordered, but not yet delivered," and is added, with date, in the column "stores on hand."

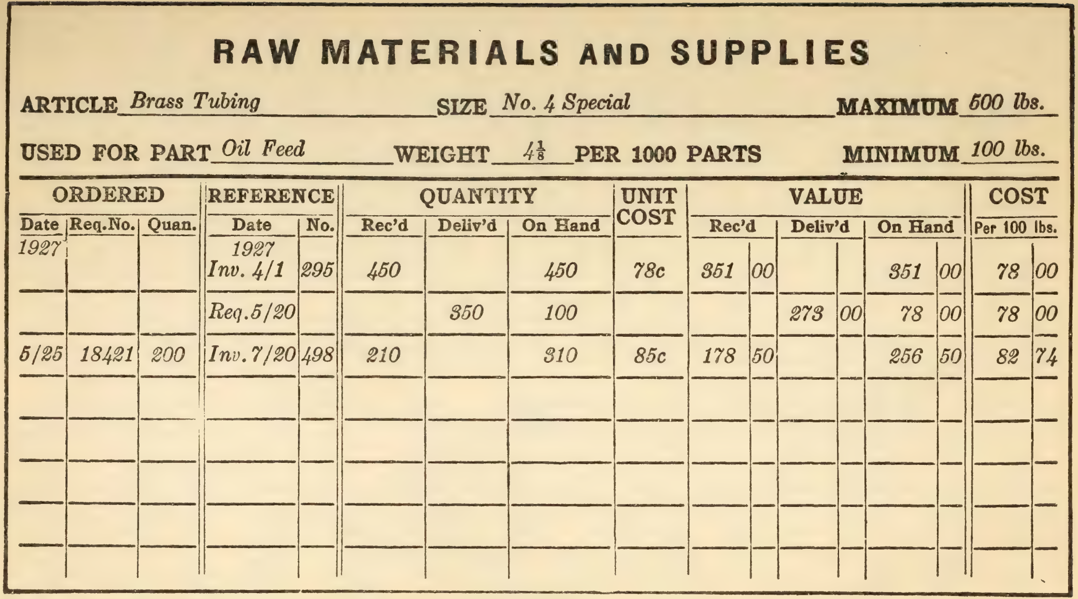
In setting aside stores for use on a particular job, the amount apportioned and the date are entered in the column "stores apportioned to an order but not yet issued from stores room," and this amount subtracted from the column "stores available." When the stores are actually issued and pass from the stores room to the workroom, the amount is subtracted from the columns "stores on hand" and "stores apportioned."

A Perpetual Inventory of Stores

Thus, the balance of stores sheet shows at any time the exact standing of stores. It shows (1) stores ordered but not yet delivered, (2) stores available, (3) stores on hand, (4) stores apportioned. Every time stores are added to or subtracted from any one of these groupings, the change is entered at once on the sheet. So its record is always up-to-date—a sure index of the condition of the stores department—a perpetual inventory of stores.

In some cases a "schedule" column is added. As soon as a certain production is scheduled to be run, the quantity of material required for it, is entered in this column. The use of a schedule column for materials regularly used in production will guard against over-ordering during a period of slack business as well as against unexpected shortages.

Whenever the stores room issues stores it must have a requisition for the amount. This form of requisition is commonly called a STORES ISSUE. It is also called a material



RAW MATERIALS AND SUPPLIES

ARTICLE *Brass Tubing* **SIZE** *No. 4 Special* **MAXIMUM** *500 lbs.*

USED FOR PART *Oil Feed* **WEIGHT** *$4\frac{1}{8}$* **PER 1000 PARTS** **MINIMUM** *100 lbs.*

ORDERED			REFERENCE		QUANTITY			UNIT COST	VALUE						COST	
Date	Req.No.	Quan.	Date	No.	Rec'd	Deliv'd	On Hand		Rec'd		Deliv'd		On Hand		Per 100 lbs.	
1927			*1927* *Inv. 4/1*	*295*	*450*		*450*	*78c*	*351*	*00*			*351*	*00*	*78*	*00*
			Req. 5/20			*350*	*100*				*273*	*00*	*78*	*00*	*78*	*00*
5/25	*18421*	*200*	*Inv. 7/20*	*498*	*210*		*310*	*85c*	*178*	*50*			*256*	*50*	*82*	*74*

ONE FORM OF BALANCE OF STORES SHEET, A PERPETUAL INVENTORY RECORD requisition. As soon as received, the stores issue is forwarded to the balance of stores clerk to enter on his record. By this means each column of the balance of stores sheet is kept continuously balanced. The minimum quantity of material to keep in stock and the amount to order when the available stock reaches a minimum must be constantly watched and frequently revised to meet the changing conditions in the factory.

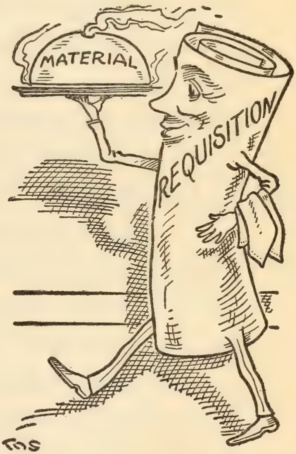
The Requisition or Stores Issue

Too often the Requisition is treated like a poor friendless waif

The requisition, or stores issue, is the storekeeper's receipt for what he hands out. The sum total of requisitions for the day must equal the sum total of material drawn out that day. It is easy to see how such a system safeguards material in the stores room. It is impossible for some dishonest employee in that department to pilfer articles from stores without being detected. It is impossible for a too generous stores clerk to hand out material indiscriminately to other employees. For everything missing from stores the clerk must show a requisition, and since the requisition must be OK'd by some foreman or other authority outside the stores department, it is practically impossible for him to come into possession of a requisition except in the ordinary course of operations.

How Requisitions are Handled

Almost anyone in the plant may be allowed to draw up a requisition, but it should be honored only if it has the OK of the proper official. Usually the foreman or other department head is the one who has the authority. If the stores department is unable to fill the requisition from stock, the requisition will be numbered and its information noted on the stores sheet. One copy may then be returned to the requisitioner as notice that the order has been placed. The other copy will be sent to the purchasing agent. The purchasing agent in sending out his order usually incloses a return postal or detachable stub on the order, which may be used by the seller to notify him of the date of shipment. When this notification is received, it may be forwarded to the requisitioner. In



If you treat him right he'll bring you what you need this way, the person requiring the material may be kept informed of the progress of his order.

A common fault in writing requisitions is to fail to give complete information regarding what is required. In many cases the storekeeper can supply the information to complete a requisition, but this should not be expected of him. Every requisition should be complete and self-explanatory. To get materials promptly and satisfactorily let your requisition leave nothing to the imagination or guesswork of the stores clerk.

Checking Materials

The balance of stores sheet, to be of value, must check with the stores actually on hand. This can be assured only by care in handling goods and records, and in checking the records. Stores checkers should check each day a number of items with the balance sheets and bin tags. This is done by actual count. The items to be checked should be taken by some irregular plan that will give no notice in advance of what is to be checked while at the same time it will cover all materials at sufficiently frequent intervals.

This checking system should insure accuracy. It should show that the amount of material on hand is correctly recorded on the bin tag. The bin tag record must check with the balance sheet and the balance sheet must be correct with its entries and in its additions and subtractions. A careless balance clerk has been known to enter the date in the wrong column and add its numerals into the material quantity. The transposing of figures in copying is a common mistake, and must be carefully guarded against.

That the balance of stores sheets may be kept in agreement with the actual stores has been demonstrated again and again. In one plant the stock room inventory made by actual count varied from the records only 0.01 per cent. When such control is maintained one may rely on the balance of stores sheet to keep materials on hand up to factory needs.

Bins and Bin Tags

Reference has been made to "bin tags." These are tags attached to each bin where stores are kept, showing the amount of material in the bins. Where large stocks are carried and it is necessary to have a surplus in a larger or "master" bin, material in the smaller bin must be exhausted before it is withdrawn from the master bin, and a master bin tag should be placed on the regular bin with the regular bin tag. This master tag should show the location and amount of surplus supply. As this supply is drawn upon to replenish the regular bin, the record must be corrected upon both tags. It is an important part of the storekeeper's job to see that the bin tags are correctly filled out and that the amount of stores on hand agrees with the record upon the tag.

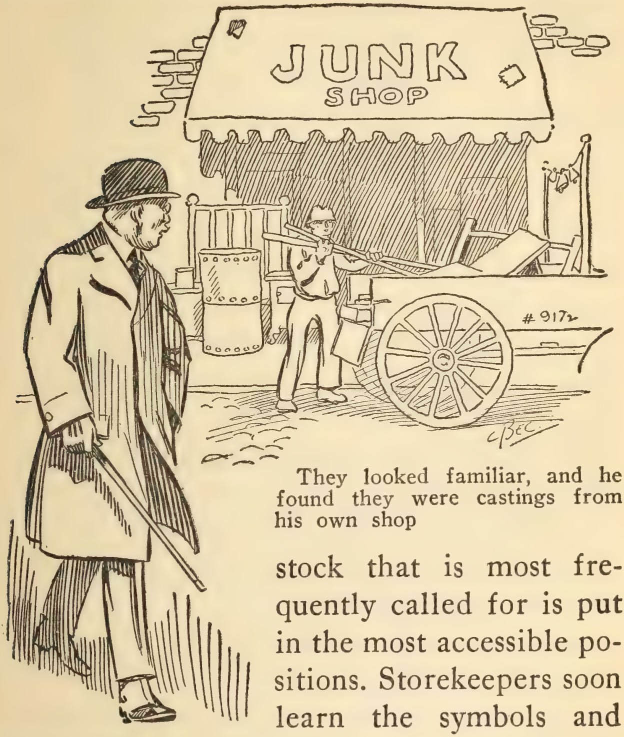
The Use of Symbols

In classifying materials for handling and recording, it is an advantage to use symbols. The symbols serve as standard abbreviations in written records, insure the use of only one name for the material, and assist in storing and finding goods according to classification. Each kind of stores should have its own classification after some logical and easily-remembered plan. The symbols should be such as to avoid conflict or confusion.

Numerical symbols are sometimes used. In this system each class of article is given a number. A disadvantage here is the fact that there is nothing to assist the memory in recalling the symbol. One must refer to the classification lists frequently in entering the less common materials.

The so-called Mnemonic system overcomes this difficulty by making the symbol of the initial letters of the material. Thus, in a symbol consisting of three letters the first letter might be S for steel, the second letter T for tool, and the third letter R for round; giving STR, meaning round tool steel. This symbol may be preceded by another to indicate the general class of stores, as SV-STR, which is interpreted: classified stores (S), for a variety of purposes (V), round tool steel (STR).

When a letter system is used, materials are arranged in stores in alphabetical order, but stock that is most frequently called for is put in the most accessible positions. Storekeepers soon learn the symbols and can quickly put their hands on any material requested.



They looked familiar, and he found they were castings from his own shop

What about the material after it leaves the stores room? The requisition system is a check on the stores department and safeguards material there. But how about material in the hands of the workman? How may the management make sure that it is not wasted or misappropriated?

Safeguarding Material through the Plant

In the first place, the function of issuing requisitions should be strictly controlled by the foreman. Usually, when a workman needs material for a job upon which he is working or which he is about to begin, he makes his request to the foreman (if the delivery of the material has not already been provided for), and the foreman or his clerk draws the requisition. As already explained, the requisition must bear the OK of the foreman before it will be honored by the stores room.

In a small department, it is possible for the foreman to keep in close touch with the details of the various jobs. Any requests for questionable amounts of material would arouse his suspicions at once, and result in a speedy investigation. But in a large department this personal check-up is hardly possible. The foreman may have a hundred or more men under him and many machines. The signing or initialing of a requisition then becomes a perfunctory matter, and unless some additional safeguard is provided, it is easily possible for the wasteful or the dishonest workman to obtain more material than his work requires.

How One Manufacturer Discovered a Leakage

A Western manufacturer discovered this in a rather convincing way one day when he passed a junk shop as a wagon-load of "junk" was being unloaded. He noticed that most of the load consisted of brass pieces. They looked familiar, and, stopping to investigate, he found that they were castings from his own shop. Of course he demanded the name of the seller, traced the "junk" back to one of his factory employees, and after an inquiry which disclosed that the man had been engaged in systematic stealing from his employer for a series of years, discharged him. Then a full investigation was made of the system which allowed such a thing to take place.

The industry was a piano factory. It had a requisition system in full force throughout all departments of the plant, but analysis showed that, in its accounting of material used in making parts, the system was weak. For example, when a primary operation was to be performed, for which raw material from the stores room was required, a job ticket was issued describing the part to be made and the operation to be performed. On the strength of this job ticket the workman would then get a requisition from the foreman's clerk. Perhaps it was a requisition for tubing, for screws, or for brass castings of the kind which the owner found at the junk shop. Whatever the material, the workman specified the quantity needed, the clerk made out the requisition, the foreman initialed it as a matter of course, and on presenting the requisition to the stores clerk, the workman got the material. After he had finished his job, the workman would turn his product over to the stock clerk.

Output Should Be Checked against Material

The weak spot in the system lay right here. There was no check of output against material. The dishonest workman had simply got more castings than he needed, and kept some of them out, carrying one or two a day home in his overcoat pocket. Nobody suspected the stealing, because for every lot of material he withdrew, he turned in a lot of finished stock.

Under the system which has since been installed in that plant, every job ticket for a part to be made from raw metal or castings calls for a specific weight of metal. The requisition is issued for this weight only; and as an additional precaution, the job ticket must accompany the requisition to the stores room. When the stores clerk fills the requisition, he initials the job ticket—thus indicating that the quantity of material called for and given out by him corresponds to the quantity specified in the job ticket. When the job is com-

MATERIAL REQUISITION

No. *275*

Sept. 20 192*7*

Oil Shed **STOREROOM:** **Please deliver to** *T. Sweeney*
(NAME OF STOREROOM) (EMPLOYEE'S NUMBER AND NAME)

The following material and charge same to *Automatic Dept.*
(DEPARTMENT STAMP)

Part No.	ARTICLE	FOR PART NO. OR SHOP ORDER NO.	QUANTITY OR WEIGHT DELIVERED	DO NOT WRITE BEYOND THIS LINE	PRICE PER UNIT	AMOUNT
	5 Gal. Mche. Oil					

Chas. Turner
DEPARTMENT FOREMAN

Automatic Dept.

DATE OF RECEIPT

RECEIVED BY

BILL NO.

DATE

THIS SPACE FOR BILLING DEPT.

pleted and the finished parts go to the stock clerk, he notes the amount of material furnished to the workman and then checks up the finished parts against this record. He is able to do this by means of a list on which is indicated exactly how many parts of each kind should be obtained from a certain quantity of material. Thus, the workman's production must check up with the record of material delivered to him, and any shortage must be explained immediately.

Many plants have found this system successful. A New York motor truck factory found it necessary to adopt a somewhat different system, due to peculiar circumstances in its manufacturing. Its production was entirely manufacturing to order. An order might consist of one truck of a special design, or it might call for twenty. In either case, requisitions for material were varied and numerous. Material issued from the stores room could not be charged to part numbers, as was the case in the piano factory, for the manufacturing was not standardized on the basis of the production of parts. Each order was separate in itself, and all costs were chargeable to the order.

So in this plant a system of budgeting the material was devised. From the full set of blue prints for the particular order to be manufactured, a schedule of all material required is drawn up. This schedule, or BILL OF MATERIAL, shows the contract or order number, the goods to be made, and the date promised for delivery. It contains a detailed list of materials required, showing for each material the number of the drawing calling for its use, the kind of material, the size and quantity. The stores clerk is authorized to recognize requisitions for each order only to the extent of the material shown upon his copy of the bill of material, or in exchange for material that has already been issued but spoiled during the course of work. As each requisition is presented, the goods delivered are checked from the bill of material, and the workman's number entered beside the item. Any demands beyond the quantity authorized upon the bill of material are investigated, and since the record shows exactly who received the goods, the responsibility for irregularity may be definitely placed.

Budgeting the Material

One successful production man has said of this budgeting system: "Where it is adaptable, it stands without parallel for safeguarding material."

There is, however, considerable work about a large plant in which it is not possible to have an exact check on material. An example is an order for the repair of machinery or equipment. On such an order, the total material cost is first estimated and this estimate is later compared with the actual material delivered upon the order. Where there are similar repairs from time to time, comparisons are made. Either way affords at least some means of checking waste or pilferage.

Of course it is the cost department, rather than the stores department, which keeps the real check on material consumption. In computing material cost for a job, the cost department will notice any excessive requirements and report them.

Work-in-Process

In the factory, raw materials cease to be known as such the moment they enter into the process of manufacture. They then become "work-in-process." The value of work-in-process includes (1) the cost of all raw material used, plus (2) the cost of all labor spent upon the material up to its present state of completion, together with (3) a proper proportion of overhead expenses. It is important to know the value of partly finished goods at any time, and in many plants an accurate detailed record is kept. This record is in a form similar to that of the perpetual inventory, or balance of stores sheet, described for raw material. It is in fact a continuation of the perpetual inventory, having its beginning where the other ends.

This record is known as the WORK-IN-PROCESS LEDGER, and is kept in either loose-leaf books or on cards. In one plant engaged in manufacturing standard parts, later to be assembled into the finished article, the card system is used, a card being set apart for each operation. Thus a part requiring six operations would be represented by six cards—one for each operation. All costs for material, labor, and overhead involved in the operation are entered upon its card. Each card shows at any time the quantity of parts on hand which have passed through the operation, as well as their cost value. As the same operation is performed again and again, valuable comparisons may be made.

In another factory, the parts may be worked through the various operations in standard lots, say, of ten thousand each. In this case all costs for material, labor, and overhead for the lot, would first be gathered upon a card; and then the total cost for the lot transferred to the work-in-process card for the part. Deductions are made and balances reduced as parts are delivered for assembly, finally to become finished stock.

The details of such a system vary with differences in plant and operation. Where a

WORK IN PROCESS

PART NO. *2742*

OPR. NO. *2*

PART NAME *Back Plate* USED ON *Model 1412* OPR. NAME *Stamp*

FROM PART NO. *(Raw Mat'l)* TO PART NO. *2842* DEPT. NO. *12*

REFERENCE			QUANTITY				VALUE						COST
Date *1927*		Source	Produced	DELIVERED		On Hand	THIS OPERATION COST			DELIVERED		On Hand	Per M.
				Sold	Scrap		Material	Labor	Overhead	Sold	Scrap		
Jan.	*1*	*P/R*	*2500*			*2500*		*4 50*	*2 25*			*6 75*	*2 70*
Feb.	*27*	"	*10000*			*12500*		*15 00*	*7 50*			*29 25*	*2 34*
Apl.	*20*	"	*5500*			*18000*		*8 00*	*4 80*			*42 05*	*2 34*
May	*12*	*S. Tkt.*		*15000*		*3000*				*35 10*		*6 95*	*2 34*
May	*15*	*S. Rep.*			*25*	*2975*					*75*	*7 70*	*2 59*

WORK-IN-PROCESS RECORD

(An operative causing "scrap" must bear the entire cost of the spoiled work) plant manufactures to order, or works upon special contracts, a card would be used for each order. Other classifications would be according to jobs, articles, or processes. The system must be shaped to conform to specific manufacturing conditions as well as what is being manufactured. The purpose of the work-in-process ledger, however, is the same in every case—to know exactly what is in process of manufacture at any time and the cost thereof.

Inspecting the Work

As work in a factory progresses from operation to operation, from minor to more complete assemblies, finally to issue as finished product, the matter of inspection plays an important part. The degree to which work is put to the test depends upon the mechanical correctness required. Unit IV has discussed the use of gauges. In the manufacture of practically every article some parts or operations are more critical than others; hence, while some parts require a 100 per cent inspection—by which is meant, every part must be inspected—others might need only a 20 per cent inspection, or the testing of one part in every five. If numerous defects are shown in a 20 per cent inspection, it might be necessary to go through the entire lot.

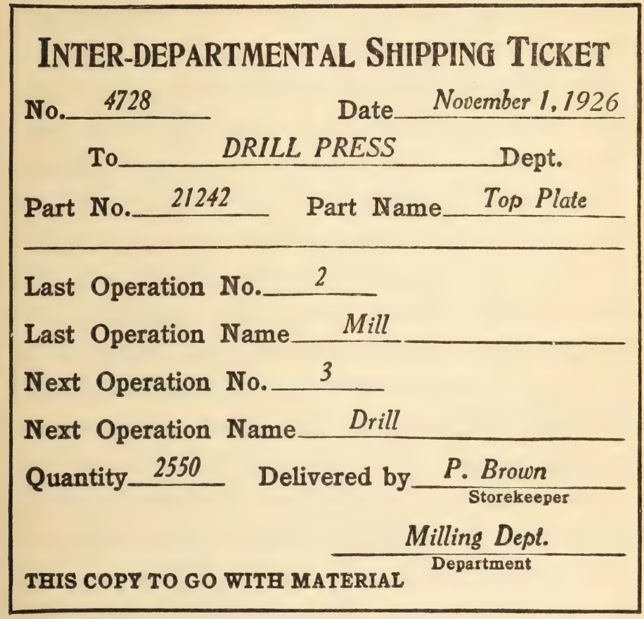
Inspection may be made at the work bench or the machine in the workroom, or it may take place in a regular inspection room equipped for that purpose. The former is usually referred to as floor inspection. Floor inspection, when it can be employed, has an advantage in that faults may be corrected while the operation is in progress, and further work thus saved from being spoiled.

Method of Handling Scrap

As work is passed upon by the inspectors, the defective work is separated, and records are made of it. These records are known as SPOILED WORK TICKETS, or scrap tickets. From these tickets a scrap report is drawn up from time to time which shows the management exactly how much work has been spoiled in each department, and the cost of it.

The spoiled work is gone over by the chief inspector, or some other competent person, with a view to finding out which parts may be repaired or otherwise utilized. If the spoiled work is in the form of assemblies, it may be put through a "knock apart" operation, and the good parts used over again.

In a large plant, all operations upon a part, article, or order are seldom performed in the same department. It therefore becomes necessary to keep the work moving from department to department. This may be done in one of two ways: (1) by direct shipment from one operating department to another, or (2) by sending all parts as rapidly as they are finished in the various operating departments to a central partly-finished-stock room, from which each part may be routed to its next operation.



INTER-DEPARTMENTAL SHIPPING TICKET

No. *4728* Date *November 1, 1926*

To *DRILL PRESS* Dept.

Part No. *21242* Part Name *Top Plate*

Last Operation No. *2*

Last Operation Name *Mill*

Next Operation No. *3*

Next Operation Name *Drill*

Quantity *2550* Delivered by *P. Brown*

Storekeeper

Milling Dept.

Department

THIS COPY TO GO WITH MATERIAL

In either case, when a department has finished its operations the goods are accompanied to their next destination by a SHIPPING TICKET. The shipping ticket form illustrated above is made in triplicate, the original going with the goods, while a copy is retained by the department sending the goods. The cost department receives the

The Shipping Ticket

third copy, and deducts the cost of the work from the work-in-process account of the department delivering the goods, at the same time charging it to the work-in-process account of the department receiving them. The original copy is signed by the receiving department, and returned, acting as a receipt.

The purpose of all these records is clear: They are to safeguard a valuable asset, material, against waste. More than that, without such records it would be impossible to know the actual cost of production, for it is on the basis of the requisitions, the job tickets, the spoiled work tickets, and other material records that the cost department gets much of its information which shows up finally in the cost summary. Thus these records not only insure against leakage of materials through carelessness or dishonesty, but they also provide valuable data for guiding future operations.

In general, the same principles that are used in preventing waste of materials and supplies are used in keeping track of tools, both in the tool cage or stores room and out in the workshop. A system of brass checks for tool accounting was described in Chapter VI of Unit IV. It is fundamentally the old idea of requisitions, worked out a little differently.

Sometimes a workman will protest against the "needless red-tape" of requisitions. He has a mistaken idea of production efficiency, and the foreman who is alive to his job will not miss such an opportunity to drive home the lesson that *records which insure against waste and cut down costs are productive factors.* They help along the success of the plant by keeping one element in production, material, moving in the right direction—the direction of lower costs.

V

Keeping Track of Fixed Assets

WHEN we come to the fixed assets, the average foreman is inclined to think that here is a subject which he can skip. The records of fixed assets are for the bookkeeper, the president, and the treasurer, he argues. What have such records to do with him? Such matters as the plant, its site, and its machinery are determined and controlled by the higher management or by specialists reporting to the higher executives. The records that keep account of such items are therefore thought of as only of indirect interest to the foreman and his associates.

The Foreman and the Fixed Assets

But this is not so. While it is true that the foreman does not usually have such direct connection with the making and keeping of such records as he has with the making and keeping of records affecting stores and their handling through his department, it is also true that a proper knowledge of the system of keeping tabs on the equipment and its value will be a big help to him in the performance of his own work and in directing that of his department. Unless he understands the operation of depreciation and its effect on plant efficiency, he will have a mistaken conception of equipment values. Moreover, he needs to be familiar with the making and keeping of plant and equipment records in order to interpret these things accurately to his men, to correct false thinking on the subject, and to give the higher executives the benefit of his experience and judgment, when called on.

Of course, when you come right down to it, there is no such thing as an absolutely "fixed" asset. Even land changes in value from year to year, and buildings and equipment depreciate with age, wear and tear, the competition of improvements, and other factors. If fixed assets were really fixed, it would be an extremely simple matter to keep accurate track of them. All that would be necessary would be a list of the assets and of their cost price. But in actual practise, the machine you pay $1000 for doesn't remain worth $1000. With use it wears out. Even if you don't use it, but simply let it stand idle in a warehouse or in a corner of the factory, the odds are that it will decrease in value through *deterioration*—the material damage of rusting, mildew, disfiguring, or other injury resulting from exposure to the elements—or through *obsolescence*—the loss in value due to improvements, the invention of more efficient machines.

This decrease in the value of plant and equipment is called depreciation. Depreciation may result from any of four general causes: (1) wear and tear and exposure to the elements, (2) accidents, (3) obsolescence, (4) inadequacy.

Causes of Depreciation

The first of these causes is continually operative, to a varying degree, depending on the equipment itself, the usage it gets, the climate, and other factors. "In one locality boilers may depreciate 7½ per cent annually, in another the rate may be 15 per cent," says Robert H. Montgomery, in his book, "Auditing." "It is not merely a question of the life of the boilers, because no experienced engineer or boiler manufacturer would answer the question until he knew the use to which the boiler would be subjected, the climate, the water, the class of labor, the probabilities of shut down, etc."

Depreciation due to accidents is obviously a sudden depreciation, and one that cannot be exactly anticipated. Depreciation due to inadequacy is illustrated in the case of a street railroad company. To meet the demands of increased traffic, larger and heavier cars were substituted. This rendered the tracks, bridges, and power plant inadequate, and replacements were necessary. Depreciation due to obsolescence has already been illustrated.

The Investment Ledger System

It must be apparent that any record of fixed assets, to be really useful, must include not only the original cost of the property but all other items affecting its present value. Perhaps the easiest and most convenient method of keeping track of fixed assets is the so-called investment ledger. In this system each item has a separate card so arranged as to provide a place for showing original cost and estimated annual depreciation, with a place for entering the value at the end of each year. Such a card is shown on page 68. It should be remarked that cost of freight, cartage, and installation of a machine is entered on the card as an "investment" rather than charged as an expense, because the cost of any piece of equipment that matters in production records is the cost of that machine set up in the plant ready to turn out goods, and not the cost of the machine f.o.b. factory.

The amount charged against the machine or piece of equipment each year for depreciation is determined by consultation with those who control the operations of the machine, and varies for each piece of machinery or equipment in the plant. It varies also, as has been said, for different localities, and again accord-

KIND OF EQUIPMENT *B. & S. 4 Spin. Drill Press* LOCATION *D. P. Dept. Post 4* NO. *2187*
BOUGHT FROM *Gibson Tool & Machine Co.* ADDRESS *New York, N. Y.*
DATE BOUGHT *Jan. 5, 1924* DATE RECEIVED *Feb. 20, 1924* COST: *$890*
ESTIMATED LIFE *20* YRS. ESTIMATED REPAIRS *$250.* FRT. & CTGE: *28.96*
ESTIMATED JUNK VALUE *$75* SETTING UP: *23.50*
DEPRECIATION PER YR. *$55.87 (942.46−75+250÷20=55.87 per yr.)* TOTAL COST *$942.46*

DATE		MEMO.	ADD REPAIRS		DEDUCT DEPRECIATION		PRESENT VALUE	
mo.	yr.							
Jan.	*1924*	*Total cost value*					*942*	*46*
"	*1925*	*For year 1924*			*55*	*87*	*886*	*59*
"	*1926*	*For year 1925*	*7*	*50*	*55*	*87*	*838*	*22*
"	*1927*	*For year 1926*	*30*	*00*	*55*	*87*	*812*	*35*

RECORD OF PLANT EQUIPMENT

In the system described in Chapter V, there is one of these investment ledger cards for each piece of equipment in the plant

ing to the hazards of accident or the chance of the machine's becoming obsolete. But the percentages of depreciation are, at best, only estimates, based on former experience. In new industries whose processes are unsettled and subject to immediate development or improvement, there should be a larger allowance for obsolescence than in industries that have been more settled and whose machinery has been highly refined.

Depreciation an Operating Expense

Since depreciation means a using up of the assets, it is considered one of the operating expenses of the business and appears each year as an expense in the Loss and Gain account. And because these assets should be replaced before any business can rightly consider that it has earned a profit, a depreciation reserve is also listed as a liability.

The expense of keeping equipment in repair is sometimes charged against the depreciation reserve, but in such cases allowance should be made in advance for such repairs by increasing the depreciation reserve annually in the amount of estimated repairs. This is done so that repairs made in any one month may not be charged against operating expenses for that month, but may be spread over a longer period of time, usually one year.

The location, as well as the value, of each machine should be definitely recorded. Of course a good production man will know the location of his equipment, but in case of fire the insurance company will require proof of loss, and the manufacturer will be at a disadvantage unless he has accurate records—records which show the location as well as the value of the equipment—to back up his claim.

Records Should Show Where Equipment Is Located

With the making and keeping of all such records, the production man may ordinarily have very little to do at first hand, and yet he should understand them. Certainly he should know and understand the essentials of the records that keep track of fixed assets, and be able to explain such things to his men intelligently when occasion arises. The production executives who have risen from the ranks have used as their stepping-stones knowledge gained from such records.

What happens when such records are not properly kept is pictured in the following interesting letter from a manufacturer to his son:

DEAR RALPH:

It makes me mad clean through to hear you say you find little at the International plant

A Manufacturer's Letter to His Son

that would be useful to us here. If you are going to make worthwhile the money it is costing us to pay your expenses investigating different plants and systems so as to better our own, you will have to get down to brass tacks right away, and learn to see the bigness of the little things.

Within the past thirty days I have had a dozen different men in our plant tell me that for some reason they lose a lot of time whenever they start a new job because it takes so long to get the tools and fixtures. I have questioned some of those who came to us from the International, and from what they tell me, getting tools over there is a little matter that takes about as long as getting an overcoat checked at the hotel coat room—and is worked about the same way.

We've spent a lot of money—and made a whole lot more—getting the best system into our business, and are willing to make further investments in the same way. Please notice that I say *invest* and not spend. I don't expect that everything you see can be picked up bodily and put right into use here; but reading between the lines of your last letter, I am inclined to tell you that unless you apply your imagination to the things you see, you will never make much headway.

Mr. Thompson dropped in on me this morning, and told me he heard you were over at the International telling them all about the fine ways we have of doing business here. Perhaps that explains why you are finding so little of the stuff you were sent for. They are pretty modest people at the International, and the chances are you have so filled them with your own perfections that they are a little afraid or ashamed to reveal theirs. Your rule No. 1 on this trip is to use your ears and not your tongue. By applying the padlock in the proper place you will find you can get a whole lot farther in much less time, and besides you will need only half the equipment.

When Lack of Equipment Records was Costly

Speaking of equipment reminds me of the fire we had at the plant five years ago. We had been pretty careful about insurance matters, and were cautious always to carry enough. We were able to talk turkey to the insurance company, and show them through the detailed perpetual inventories just how much raw materials and supplies we had on hand; and the same was true of our work-in-process. We had little trouble, therefore, in making a satisfactory deal on these. However, when we came to talking about the equipment and machinery, I felt pretty foolish, I can tell you. We simply had to surrender hands down, and take the terms offered. Here we were, one of the biggest plants in this section, and one of the best equipped, too, but all we had to show for it was an account in the ledger called "machinery and equipment," which said we had some of that to the tune of about $450,000. When we wanted to find out how this amount was made up, or in other words, just what part of this each machine represented, we simply had to wave the white flag. It couldn't be done.

The insurance company had their appraisers about the plant for a few days, and when they suggested an appraisal of the machinery which the fire hadn't damaged, they to pay the difference between this and the total figure, it looked to me like a good scheme. I changed my mind, however, when the appraisal figures footed up to a little over $400,000; and since I lost fully a quarter of the plant, I felt pretty sore, and was sure I was getting a raw deal. I wanted to fight. But they were the most amiable people you ever saw, and when they suggested a second appraisal by two experts, they to select one and I the other, I naturally had to agree.

"We simply had to surrender, hands down"

We might have saved the fees, however, for the result was about the same. I took the $50,000 they offered and figured my lack of equipment records cost me another fifty. It also showed me where being too conservative cost money; for we had been writing off a fixed percentage each year to cover the depreciation on all the machinery, while as a matter of fact there are hardly two machines in the plant with the same life. Besides this, as I afterwards learned, a good part of the equipment we made ourselves never found its way into the equipment account. These things explained of course why the machinery and equipment valued on our books as $450,000 was in reality worth a good deal more, and why I collected only $50,000 when I should have received at least $100,000.

The Investment Ledger

However, I have used that experience many times since the fire, and that fifty thousand dollars has come with interest since then. Today, as you know we have a complete record of every piece of machinery in the plant. Each machine is numbered, and is recorded in detail on a card bearing that number. Instead of using a fixed rate for depreciation on all machines alike, each machine is considered separately. While formerly, little attention was given the equipment we made, it makes no difference now whether we make it or buy it outside. For that made here, accurate costs are kept of the material, labor, and overhead. Now when our books say we have $800,000 worth of machinery, I need only refer to the INVESTMENT LEDGER, to find out what part of that $800,000 each piece represents. Since each card gives the location of the machine, we can now in case of fire, give a true account of each machine, and be in a position to collect one hundred cents on the dollar—instead of fifty.

I simply mention this in passing, to point out that in an up-to-date manufacturing plant nothing is little—everything is big. And if "many a little makes a mickle" is a good enough slogan for generations of people to follow, it certainly ought to be good enough for us to carry into our plant to help beat the other fellow when it comes to making typewriters.

Your father,

JOHN RUSSELL.

VI

Maintaining Efficiency of Equipment

THE problem of keeping the equipment fully productive is largely a matter of keeping up the efficiency of the workers who use the equipment. If a man is an idler, his machine is necessarily a time-killer too.

Causes of Machine Idleness

But this does not mean that all machine idleness is due to this cause. Often the worker is a thoroughly capable man, and keeps busy all the time, and yet his machine fails to turn out all the work of which it is capable. It is possible for a whole department to rate close to 100 per cent of production from its man power, and yet rate low in percentage of production from its machine power. Such a condition may result from over-sized equipment, poor teamwork between machines, unexpected break-downs and frequent repairs of equipment, and other such causes. Let us consider in this chapter the records that help the executive to keep his equipment operating as near as possible to capacity.

There are four kinds of information that the man in charge wants to know about his equipment:

1. What is the output, and can it be increased without a radical change in design?
2. What part or parts are most frequently in need of repair or replacement, and what is the cost of repairs and upkeep?
3. How much of the time is it idle, and for what reason?
4. Can the design or construction be improved so as to cut down production costs, or can a new process or machine be substituted for this purpose?

These questions govern the selection of machinery in the first place, and they govern the handling of equipment throughout its lifetime. Records that keep tabs on this information are naturally of great assistance in making equipment do its full work.

Recording the Output

What is the output? The easiest means of recording the output of a machine or piece of equipment is to use a mechanical counting device, similar to the so-called "clock" on a linotype machine or the counter on a printing press. Of course such devices make no distinction between good and bad work. They count all alike, and it is therefore necessary to have somebody count the spoiled work and subtract it from the total shown on the automatic counter.

This mechanical device cannot be attached to all types of equipment, and in such cases other means of keeping output records must be resorted to. The job ticket is itself a way of keeping such records. It bears the number of the machine or apparatus used in performing the operation and a record of the time required. At the end of the day it is a simple matter to total up the job tickets for each machine, and from this arrive at the output per machine per hour.

Where the piece of equipment is one that performs a continuous operation—such, for example, as a retort in a chemical factory, a flour mill, the cupola of an iron foundry, or the grinding machine in a paint plant—neither the automatic counter nor the job-ticket method is practicable. What method is used depends naturally upon the character of the product and the unit by which its quantity is reckoned. There are automatic weighing machines that will take the product from the hopper, weigh each batch, enter a record of the weight, and then dump the product into a bin or conveyor ready for the next process.

In many cases mechanical counting, weighing, or measuring of output is not possible or practicable, and then the task must be performed either by the workers themselves or by special counters or inspectors assigned to do this. Then you are confronted with all the possible variations in human nature, and the work of recording may be well or poorly done, according to the capability of the person intrusted with it. The problem becomes one of handling men as well as handling records, and must be dealt with accordingly.

When the Human Factor Enters In

In the plant of the Barber Asphalt Paving Company at Maurer, N. J., there was a huge machine, more than 200 feet in length, that turned out asphalt roofing. The untreated felt was fed in at one end of the machine, and in passing through, it was first saturated and coated with asphalt, after which a mineral surfacing was applied, and then the finished sheet was cooled, wound into rolls, wrapped and sealed for the market. Such rolls contained a fixed length of roofing and were sold on the basis of square measure, not by weight. Therefore, any roll which weighed above the adopted standard weight meant a waste of raw materials and consequent loss to the company. On the other hand, any rolls which weighed below the minimum tolerance had to be discarded into "seconds" and sold at a much lower price than first class goods, and this also meant a loss to the company. The management at first found it an exceedingly difficult problem to keep the rolls of uniform weight.

The rolls were weighed at the packing end of the machine and the weights recorded. This end of the machine was on the floor above the saturating and coating section, where the amount of materials used could be controlled. A bell signal operated by the weigher at the packing end told the men in charge of saturating and coating when rolls were running too heavy or too light; but in spite of this signaling scheme, the rolls kept running out uneven in weight. Then somebody suggested that the record be kept in the form of a chart showing by means of a line from left to right how the weights were running for each day. This was done. It was explained to the men that overweight would be indicated by the line inclining upward, and underweight by its dropping downward, and that their effort should be to keep the line horizontal at standard weight. The cost and danger of overweight and underweight were of course explained to the men, so that they understood the importance of avoiding zigzags.

That scheme worked wonders. The whole crew got interested in the game of keeping the

Records That Stimulate Interest and Cooperation

line straight. They constantly watched the chart, and the minute a kink showed up it was promptly smoothed out and kept out. The result here was not only to increase the efficiency of the equipment, but also the efficiency of the men. The direct cause of it was the improved record system provided by the chart in its graphic way of reporting the facts. The same facts had been just as faithfully reported before by the signal bell. But the chart introduced the picture idea—the men could see the progress of their production—and their interest was appealed to in a way that had never been possible with the signal bell. This element of human interest is an important one to keep in mind in planning record systems and forms which involve human cooperation, because the battle is half won when you have got the interest of the workers.

The incident in the roofing plant is also a good example of how records may be used to stimulate production. In too many factories where careful and accurate records are kept, only the cost department and the executives ever see the records. Rivalry and pride in workmanship are powerful incentives to effort, and by the judicious use of records these instincts may be appealed to. The production executive who neglects the opportunity offered by his records to stimulate efficient production should not be surprised at a lack of teamwork between his employees and his equipment.

Increasing the Speed

The management wants to know not only the output, but the possibility of increasing it. Perhaps the machine can be operated at a higher speed. Reference to records of performance will show whether present speeds are lower than those of the past. Maybe the machine has never exceeded its present speed. Then the question arises, can the speed be increased without danger of breakdown or other injury? The answer to this question is largely to be found in the records of the master mechanic or chief engineer who knows the construction and design of the machine and the limit of speed it may safely be expected to make. However, on the safe side of this limit, is another question. How fast can the operator be reasonably expected to work without danger of accident or too great a proportion of spoiled work? The inspection records and the output records for all machines in any one class will reveal the answer to the question. Often they will indicate that a considerable increase in output can be attained by increasing the speed of the machine through the addition of a simple safety device or the inexpensive strengthening of some part or enlargement of another.

Knowledge vs. Guess-work

In industries where chemical changes are effected in materials, records of quality or composition of output from apparatus have been of the utmost importance in controlling the operation of such apparatus. Without records, every operation would be an experiment. With them, the process is based on known facts and is therefore more speedily and efficiently performed. In the iron founding industry, for example, before the application of chemistry and the records built upon chemical research, the iron maker had to keep on the lookout for every little change in the appearance of this material, so uncertain was the process of converting molten iron into pig-iron. Such things as oxide films formed on the surfaces of molten iron and the jumping of sparks from the stream of iron running on the cupola spout were guides as to what to expect and signals of danger or bad mix ahead. Today the exact composition of the mass is known. Records enable the iron maker to forecast melting results. He expects bright sparks with lower ranges of silicon, whereas formerly they occasioned great alarm if dead soft castings were wanted. Such phenomena are now watched only to check up cupola practise. The development of accurate records of cupola practise has meant a tremendous saving to the iron founding industry in cutting down the production of scrap. It is recognized that economy dictates that it is better to make few molds and have them perfect than to fill the shop with specimens of the molder's handiwork and lose a big percentage through imperfections resultant from haste and carelessness. And records have been the foundry executive's chief aid in eliminating carelessness and haste.

Records of Repairs

Records of repairs are of prime importance in enabling the production executive to maintain the efficiency of his equipment. How they aid in the operation of an efficient inspection system has already been explained in Unit IV. They should be used not only to anticipate repairs by having spare parts on hand, but to render repairs unnecessary by changing methods of operation or making slight changes in machine design where possible. On such records depends the decision whether or not equipment is earning its own way. The alert production man will be able to control the cost of upkeep of his equipment only if he *knows* what the cost is. To this end he ought to know the cost of lubrication of machinery and be able to determine what lubricants are giving the service expected of them and whether or not supplies are being wasted. It has not been found possible to keep an exact record of the oil and supplies for each machine in any department. Such records would involve more time and expense in the keeping than the saving they would effect. However, supplies are usually charged to departments as a whole, and by keeping a careful watch on the cost of machine supplies each foreman will be able to determine which machines are extravagant users of oil and which are economical. More often than not it will be discovered that an adjustment here or there will stop many leaks.

The Waste of Idle Machinery

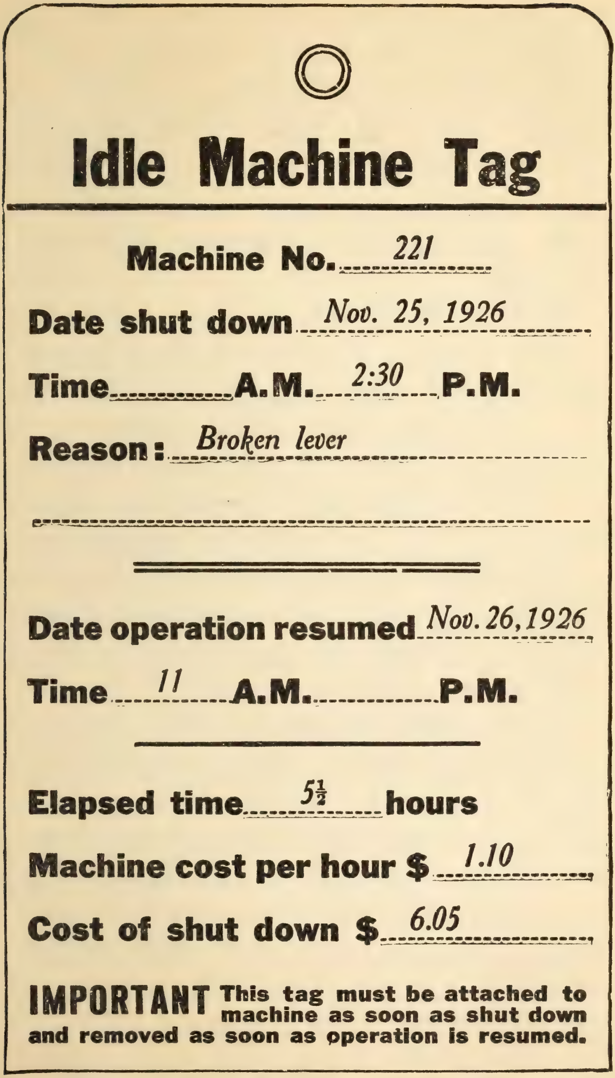
One of the greatest economies that has been effected in recent years by the proper use of records is the cutting down of idle machine time. As in all other factory problems, the first requisite is the actual facts. Even though over-equipment is to be preferred to under-equipment, as explained in Unit IV, industrial engineers found a number of years ago that much avoidable loss could be traced to idle time of machinery. Waiting for work and waiting for repairs were found to be the two most common causes of idle machine time. Adequate inspection and forehanded methods reduce idleness due to repairs, as explained in Unit

IV. How careful planning and the use of records can reduce idleness due to waits between jobs was explained in Chapter III of this Unit.

An effective device for reducing idle machine time is the IDLE MACHINE TAG, illustrated on page 87. How such a tag is used in one factory was explained by its manager recently.

The Idle Machine Tag keeps things moving

"The moment a machine becomes idle," he said, "no matter what the reason may be, one of these red tags is affixed, the date and hour is written on the tag, and the reason for idleness is noted. When the machine is again put into operation, the tag is removed and the date and time noted. From these tags the idle time is figured and the causes analyzed. Every Saturday a report is made for each department, and each foreman called to explain the machine idleness in his department. This scheme has worked wonders. The first week the discovery was made that 14 per cent of the machinery in the plant was idle for one cause or an-



Idle Machine Tag

Machine No. 221

Date shut down Nov. 25, 1926

Time ________ **A.M.** 2:30 **P.M.**

Reason: Broken lever

Date operation resumed Nov. 26, 1926

Time 11 **A.M.** ________ **P.M.**

Elapsed time 5½ **hours**

Machine cost per hour $ 1.10

Cost of shut down $ 6.05

IMPORTANT **This tag must be attached to machine as soon as shut down and removed as soon as operation is resumed.**

This form of tag keeps down machine idleness other—one because of a minor repair needed, another because no work was ready, a third because of an absent operator. Think of it! One-seventh of the plant absolutely wasted. One floor out of every seven—for which thousands of dollars are paid annually for rent, light, heat, power, insurance,—allowed to stand idle.

Making the Foremen See It

"We lost no time in educating our foremen, as well as every workman in the plant, as to the meaning of idle machinery. We photographed several machines, and showed in a schedule below just how much it cost to maintain them. We showed the exact time each day the machines were not in use, and the total idle time for the week. We gave the reasons for the shutdown, and explained how the idle time could have been reduced.

"As a result, the men have been impressed with the fact that an idle machine is expensive. It had never occurred to some of our best foremen that idle machinery is sometimes even more costly than idle workmen. Quick improvement followed, and the percentage of idleness steadily decreased. After a couple of months it found its level around 2 per cent, which we think reasonable for a plant of this kind. That little educational work did the trick. We find it generally true if you take the men into your confidence, explaining things carefully—not simply telling them, but showing them—they will play the game fair. We did this by means of the photographs. They saw and they responded.

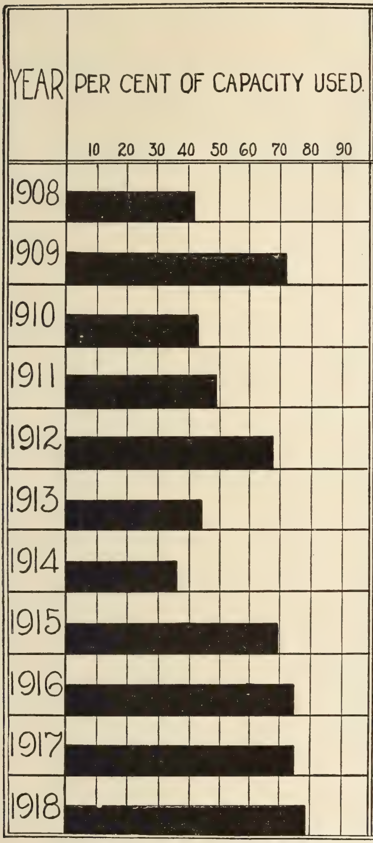
"We continue the red tag, however. It is decidedly unpopular, but mighty efficient. As soon as one is attached to a machine, the foreman on the job takes quick action to get the red tag removed."

A certain amount of machine idleness is unavoidable. Even when the plant is operating continuously, on both day and night shifts, machines will occasionally have to be shut down for repairs or for overhauling. The machine idleness which foremen and superintendents must fight is the avoidable idleness—the idleness caused by excessive delays in starting, unnecessary waits between jobs, avoidable delays in getting repairs put through, and the like. A remarkable example of how efficient planning and careful supervision, animated by a purpose to utilize equipment to the maximum degree, reduced avoidable idleness of equipment from more than 54 per cent to less than 2 per cent, is given in the records of blast furnaces for the eleven years from 1908 to 1918. These records were compiled by Walter N. Polakov, an industrial engineer, and show that whereas in 1914 the expense of avoidable idleness of American blast furnaces totaled $102,400,000, in 1918, due to the greater utilization of equipment forced by the war, this avoidable idleness shrank to such an extent that it totaled only $4,330,000.

Guides to Improvement of Design

There is still another service rendered by the records of equipment performance. Such records constitute valuable guides toward the improvement of the equipment by radical changes in the design, or by substitution of another machine or process altogether for the one now in use. The value of such records in this connection was brought home to American manufacturers during the war, when the lack of them made necessary many costly experiments in the effort to increase the man-power of the nation by greater utilization of mechanical equipment.

A careful study of the performance records of mechanical equipment will indicate whether or not a proposed change in design or construction will be effective in cutting manufacturing costs. If we know definitely the operating cost of our equipment per unit of output, it is not a hard matter to determine whether or not this cost can be cut by making the machines automatic or by substituting another process entirely. Improvement of



YEAR	EXPENSE OF IDLENESS				
	TOTAL (DOLLARS)	UNAVOIDABLE		AVOIDABLE	
		%	AMOUNT	%	AMOUNT
1908	68,800,000	13.3	18,800,000	35.2	50,000,000
1909	40,650,000	18.6	27,000,000	9.4	13,650,000
1910	87,700,000	11.2	17,400,000	45.3	70,300,000
1911	83,500,000	12.8	21,300,000	37.7	62,200,000
1912	58,500,000	17.3	30,300,000	16.1	28,200,000
1913	101,800,000	11.5	20,350,000	44.0	81,450,000
1914	120,000,000	9.3	17,600,000	54.3	102,400,000
1915	57,500,000	18.0	34,200,000	12.4	23,300,000
1916	61,900,000	19.2	46,100,000	6.6	15,800,000
1917	66,300,000	19.2	49,900,000	6.3	16,400,000
1918	62,330,000	20.0	58,000,000	1.5	4,330,000

THE FABULOUS COST OF PLANT IDLENESS

This chart is adapted from one drawn by Mr. Walter N. Polakov to illustrate the cost of idle equipment. It represents the record of blast furnaces in the United States during the years indicated, and shows the expense of idleness, both avoidable and unavoidable. Similar statistics could be compiled for many other industries.

machinery should always be guided by such records. Otherwise, it is nothing but costly experimenting. Since the industrial executive responsible for the operation of equipment is the one to whom industry looks for progress in the development and improvement of equipment, he should know definitely the capabilities of his present equipment. Such knowledge can be based only on adequate records.

The Foreman's Own Records of Equipment

Where the plant is backward in providing a comprehensive system for keeping tabs on the efficiency of its equipment, the foreman can increase his value and prestige many times over by keeping such records on his own account. Even if the plant has its own record system, the alert foreman will keep some records of his own by which he can readily check up the facts. Commenting on this, an experienced industrial executive recently said:

"It is my experience that many foremen come in for criticism because they fail to keep records of their own, showing the possible and probable capacity of their equipment. Too often an otherwise efficient man depends here on memory or guesswork, and when his memory slips a cog or his guess misses fire he is almost sure to lose standing. He loses standing with his men as well as with the management.

Records of past performance, of breakdowns, of life of equipment and accessories, are certain to come in handy. Many foremen are called on to assist in estimating and planning; when they haven't any records to fall back on, they often make a sorry showing.

"Again, foremen who keep such records and use them when called on for information are the men who impress themselves on the management as careful, painstaking, accurate, thorough, and dependable. Such men are always in demand, and men in the foremanship who show these qualities are bound to rise."

VII

Keeping Production in Step

IT is said that while the great Equitable Building was yet under construction in New York, all of its 2600 rooms were rented. The owners were able to sign leases for the rental to begin on a certain day, because they had a contract with the builders calling for completion of the work within 365 days. Should they fail to complete the building within that time, the builders agreed under their contract to pay a large money penalty for each extra day required. Since the rent totaled $3,000,000 a year, or $8219 a day, the owners felt justified in requiring this protection. No necessity for exacting penalties arose, however. The work was completed on the dot, the tenants took possession on the day agreed upon, and the owners began to receive income from the building exactly on the day they had set.

In the case of a product so large and costly as an office building it is easy to see how delay in production costs money. Until the building is actually produced—that is, completed

—it renders no service to its owner; he can make no use of it himself, nor can he rent it and thus get an income from it. All the money invested in the land upon which the building stands and in the steel, stone, concrete, and other materials used in construction, is idle—is returning no benefit. Moreover, taxes are being paid upon the land, with no resulting benefit. When the investment runs into millions of dollars—as was the case with the Equitable Building project—the loss mounts up rapidly to an enormous total which is reflected directly in the rent.

How Delay Runs Up Costs

The costliness of delay is not so readily seen in the case of a factory producing an article of small unit-value. And yet, the conditions are essentially the same in both cases. The longer it takes the watch factory to make 10,000 watches, the higher is the cost of each watch. The labor may be paid entirely on a piecerate basis, but all the other factors of expense are directly influenced by time consumed. First of all there is the money invested in steel, brass, nickel and other parts, just as in the case of the office building there was the money invested in stone, concrete and other material. The longer it takes to produce the watches, the longer the investment in material is tied up. Frequently it is borrowed money on which the factory is paying a bank 6 per cent; and even if not borrowed, it is idle so long as it is awaiting turnover from material into salable goods. It is money that could be put in savings banks or into Government bonds and made to earn a good interest with practically no risk at all! Therefore, every additional day it is idle pushes final costs up another notch.

Moreover, the money invested in equipment represents additional capital upon which interest or its equivalent must be reckoned for every unnecessary day spent in turning out the 10,000 watches. And taxes on the factory property and all other indirect expenses are piling up constantly. A simple analysis of the elements entering into the cost of production shows quickly that in any kind of production—whether it be the production of articles of small value, like shoe-laces, or of high value, like skyscrapers—any increase in the *time* spent upon production increases the cost. And the reverse is also true: *Any decrease in the time spent upon production decreases the cost of production.*

What the good factory man is constantly striving for is rapid turnover—by which is meant rapid conversion of raw material into finished goods, and of the finished goods into cash. It is rapid turnover that enables him to keep up with competition by making one dollar earn a profit several times during the year. We have already indicated how wise purchasing and the use of records can secure rapid turnover and prevent the tying up of money in material. But this is only half the story of rapid turnover. Material is only one element of cost. Wages and the expense of plant and equipment are the other elements, and the secret of rapid turnover is as largely one of reducing waste time throughout the factory as it is in securing rapid turnover of material.

Rapid Turnover Is Sought

There is a distinction between productive time and waste time, from the standpoint of rapid turnover. Of course no time spent on production is ever really wasted if the product can be sold at a profit, but the most productive time is that expended on materials for which there is a ready market. So the production executive who seeks rapid turnover must keep his organization at work on goods for which he has a known market rather than piling up goods for the warehouse.

We are looking now from the standpoint of the general manager or superintendent. He must *know* what every department of his factory is doing, and which departments are available to be switched over to the production of a rush order, if necessary. He must know that there will be no delays in the execution of this order. His entire factory must keep in step. Here records constitute one of his most valuable aids. To the production executive at the head of the force and to all the members of the force, records are like the signals given by the captain of a baseball team and acted upon by the players. To be efficient signals, they must be based on exact knowledge of the game at all its stages, they must mean something definite, and their meaning must be understood by those for whom they are intended.

Some Controlling Authority Is Necessary

In large or small production teams, somebody must be captain. He must direct the operation of the whole team. In large organizations, this is the function of the planning department, as explained in Unit III. All factories are not large enough for a planning department, but even in small factories there is an active team captain and what is said here about the planning department and its records applies as well to the functions of the manager who directs his production team without the aid of a planning department as such.

Whenever an order is received or the production of anything considered, the details of the undertaking are carefully considered by the authority that plans the work and lays it out. In the case of building construction, ship-building or a large machine shop, this may be the engineering department that makes the plans and specifications for the work. After such preliminary plans have been carefully made, they go to the planning department, the active captain of the production team. In some shops there is no engineering department and the planning department initiates the plans for the work.

The first "signals" used by the planning department are the records which indicate the routing of the work throughout the plant. These records show how each department or machine stands on the schedule of work already in process, and indicate when and where new work may be assigned. Moreover, they show how similar work has been handled in the past, and guide the planning department in picking the right men and equipment to handle the work contemplated. In all of this analyzing and planning, the foremen of the various departments and the records they have handed in, are of the greatest assistance and value to the planning department.

On the basis of its planning and organization of the work, the planning department issues a PRODUCTION ORDER for the new job. When OK'd by the superintendent, this goes to the producing departments and is their authority for taking up the new work. The production order gives all details of the job, lists the various operations to be performed and the departments that are to perform them, indicates the schedule which the work is to follow, and specifies rates to be paid for the various operations. A copy of this order is sent to the cost department and becomes a part of its records for determining the cost of the job.

The Production Order

Mention has been made in Chapter III of the use of job tickets. Job tickets are issued on the basis of the production order. The production order is the central and guiding record that governs the production of the entire order, whereas a separate job ticket may be made out for each operation to be performed, or even for each workman.

When the order calls for an entirely new product, special care is given to the supervision and study of the work as it proceeds, in order that the one best way of performing each operation may be determined. Especially where the work is done on a piecerate basis, it becomes necessary to make time studies and establish

Piecework Rate Cards

standard time for performing each operation. In such cases a time study expert is employed, and with a stop watch he times the various operations at the machine and at the work bench, records them carefully, and thus there are provided accurate data for fixing the rates to be paid, reckoning the time required, and the costs. After one job has been completed, these figures are available for planning future

Part Name................................ **No.**..........

Where Used................**Supersedes No.**..........

Opr. No.	OPERATION NAME	PRICE	
	SCREW DEPT.		
1	*Form, Drill, Turn and Cut Off*		
2	*Tapping*		
	LATHE DEPT.		
3	*Turning and Facing*		
4	*Finish Turn*		
5	*Face Two Sides Complete*		
	DRILL PRESS DEPT.		
6	*Mill*	*1*	*00*
7	*Lap and Burr*		*70*
8	*Dr. and Ctsk. Holes Rm. D.P. Hole*	*1*	*00*
9	*Tap Screw Hole*		*20*
	POLISHING DEPT.		
10	*Grain Polish One Side*		
	BLACKSMITH DEPT.		
11	*Blue*		
	LATHE DEPT.		
12	*Polish to Gauge*		
	ASSEMBLING DEPT. (Finished)		

Piecework Rate Card

jobs. A convenient form of record for conveying such information to the various operating departments is the PIECEWORK RATE CARD. It is both a rate card and a routing card, showing the order of work from department to department. Rates are extended so that each department gets only the piecerates covering its work. In the illustration, for example, rates are given only for the drill-press department, showing that this card is intended for that department.

Production orders are numbered consecutively, and jobs are referred to by their order numbers. All subsidiary records, such as job ticket, rate cards, and the like, are identified with their order by the order number. The production order also refers to the drawing number, when blueprints are used, and the blueprints may accompany the order when it goes from the planning department to the various foremen.

The Job Instructor

In addition to the production order, some plants, such as printing plants and others that produce goods to the order of customers, use a JOB INSTRUCTOR. It is a form on which are written out all instructions to the workman. Sometimes these instructions are written on the job ticket.

In chemical plants, such data takes the form of formulæ and records that have been made up by the laboratory. Such plants must continually test their product by laboratory tests. In sugar factories, for instance, such tests are highly important.

In shoe factories, the order department enters in the order book all the details regarding the samples upon which the orders were secured. Each lot is given a number. Tags bearing this number and the details regarding the preparation of the shoe upper, with one tag for each two dozen shoes, are sent to the foremen of the cutting rooms. Other tags containing details about the sole leather to be used are sent to the foremen of the sole-leather departments. A third lot of tags is prepared for the direction of the foreman of the making or bottoming room, where are brought together and assembled the various parts of the uppers prepared in the cutting and stitching rooms and the bottoms prepared in the sole-leather room.

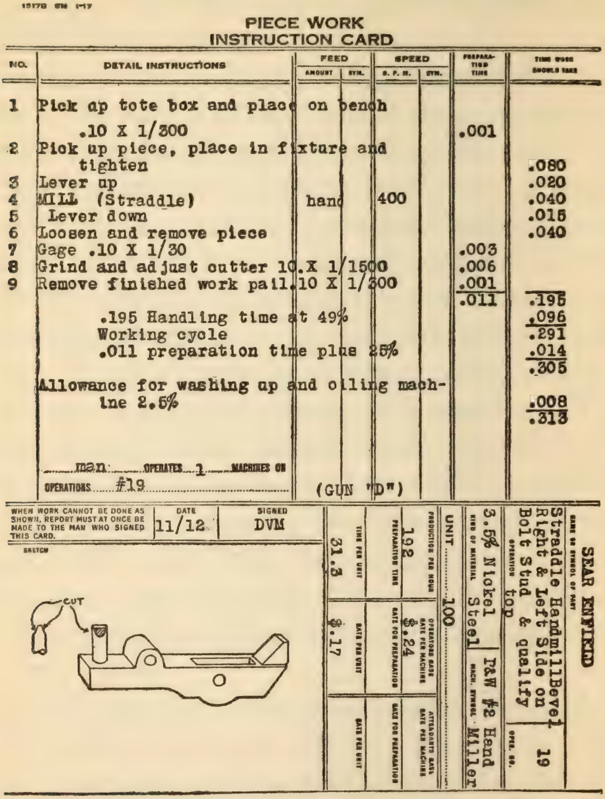
Each industry has its own form of job instructor or job ticket. All have the same purpose, to give concrete instructions to foremen and workers as to what is to be done on each order. And usually the time in which each operation should be performed is indicated.

In addition to production orders, there are SHOP ORDERS. These are orders for the manufacture of something to be used within the plant. Thus, a machine shop might make a certain number of tools for use in the shop. The order calling for the manufacture of tools would be a shop order. The production order applies only to manufacturing goods for sale, not for the factory's own use. Shop orders are assigned their own series of numbers, to avoid confusing them with production orders. Copies of the shop orders are sent to the cost department, and all tools or other supplies manufactured on shop orders are charged against the department or job in which they are to be used.

Shop Orders

The planning department keeps a carbon copy of each order issued, both production and shop orders, and as the work is completed and so reported to the planning department, it removes its copy to a "dead" file. Thus the orders in the live file show at any time the uncompleted work then under way in the factory.

After the production order has been issued, it is important to follow up the work and see that each part of the job is completed on scheduled time. The foreman in one department must keep up with the production in the other departments. If he lags behind, even in the production of a small part, his failure to keep up to schedule may delay the entire production. If he booms ahead and turns out work faster than the schedule calls for, he clogs up the stock room with surplus parts. What he should have done, was to utilize his department part of the time on other work for which there was immediate use.



PIECE WORK
INSTRUCTION CARD

NO.	DETAIL INSTRUCTIONS	FEED AMOUNT	FEED SYM.	SPEED R. P. M.	SPEED SYM.	PREPARATION TIME	TIME WORK SHOULD TAKE
1	Pick up tote box and place on bench .10 X 1/300					.001	
2	Pick up piece, place in fixture and tighten						.080
3	Lever up						.020
4	MILL (Straddle)	hand		400			.040
5	Lever down						.015
6	Loosen and remove piece						.040
7	Gage .10 X 1/30					.003	
8	Grind and adjust cutter 10.X 1/1500					.006	
9	Remove finished work pail.10 X 1/300					.001	
						.011	.195
	.195 Handling time at 49%						.096
	Working cycle						.291
	.011 preparation time plus 25%						.014
							.305
	Allowance for washing up and oiling machine 2.5%						.008
							.313
	man OPERATES 1 MACHINES ON OPERATIONS #19	(GUN "D")					

WHEN WORK CANNOT BE DONE AS SHOWN, REPORT MUST AT ONCE BE MADE TO THE MAN WHO SIGNED THIS CARD.

DATE 11/12

SIGNED DVM

SKETCH

NAME OR SYMBOL OF PART: SEAR ENFIELD
OPERATION: Straddle Handmill Bevel Right & Left Side on Bolt Stud & qualify top
OPER. NO.: 19
KIND OF MATERIAL: 3.5% Nickel Steel
MACH. SYMBOL: P&W #2 Hand Miller
UNIT: 100
PRODUCTION PER HOUR: 192
PREPARATION TIME
TIME PER UNIT: 31.3
OPERATORS BASE RATE PER MACHINE: $.24
RATE FOR PREPARATION
RATE PER UNIT: $.17
ATTENDANTS BASE RATE PER MACHINE
RATE FOR PREPARATION
RATE PER UNIT

In factories where the work is carefully standardized, the planning department may issue an instruction card with each job which specifies how the work is to be done, the time required for each operation, the rate to be paid, and other information

Efficiency calls for an evenness of production.

Keeping Up to Schedule

In order to keep work up to schedule, the superintendent or foreman must know two things: (1) how much he is expected to produce within a given time, and (2) how much of it he has produced at the end of any day or week. Such information as this cannot be carried around in one's memory—certainly not in a plant of any size. A record is necessary, and here use may be made of some such arrangement as the progress charts illustrated in Unit III.

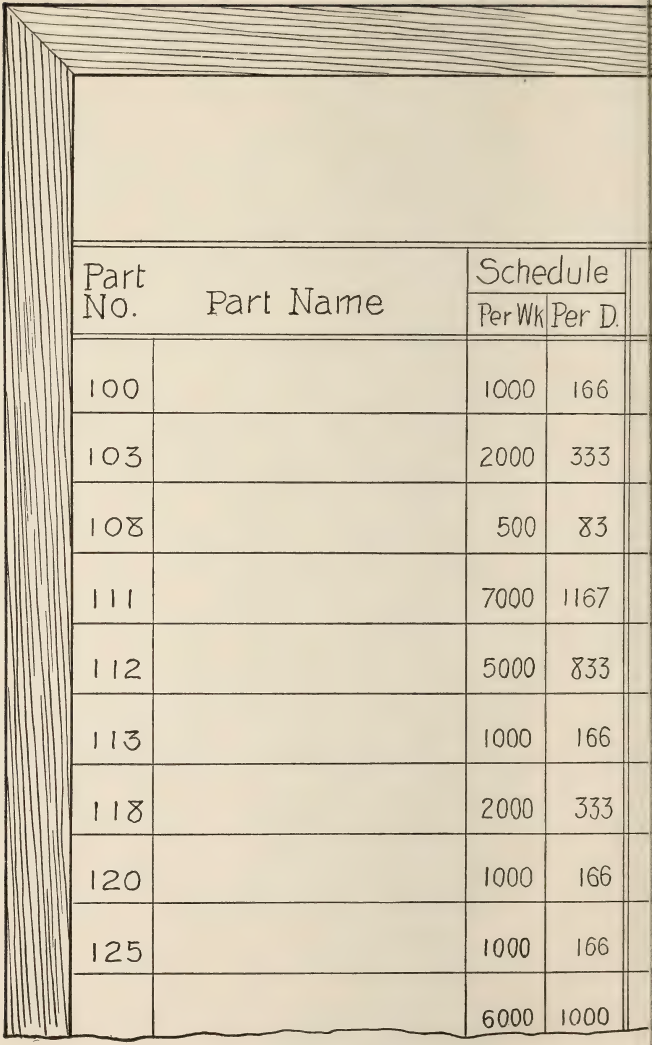
A complete and satisfactory scheme for keeping constant tabs on production was devised by an organization that manufactures phonographs and dictating machines. This plant comprises eighteen operating departments, employing about 3000 workmen, and it is easy to see that opportunities for confusion and delay would be numerous. One of the departments is called the automatic-machine department because of the type of machines used. Ten thousand different parts go into the making of the different models, and about seven thousand of these are made in the automatic-machine department. All the parts made here are forwarded to the various other departments for further operations and assembling.

The foreman of this automatic-machine department has under him one hundred and twenty-five men and about three hundred automatic and semi-automatic machines of a dozen different types. His problem is to keep all the men and machines busy, and in doing so to turn out each of the seven thousand parts in such evenly-balanced quantities that they will meet the scheduled requirements. The scheme used to control and guide this production is represented by the SCHEDULE BOARD illustrated.

This board is made by the planning department and kept up-to-date in the department in which it is used. Here is how it is done. The number of machines to be manufactured each month to supply the sales department with the output required for the year, is known. The number of each part going into each machine is also known, and from this it is a simple matter to figure the number of parts required for the total production. On the basis of this information a schedule board is drawn up for the automatic-machine department, and similarly one is made for each of the other seventeen departments.

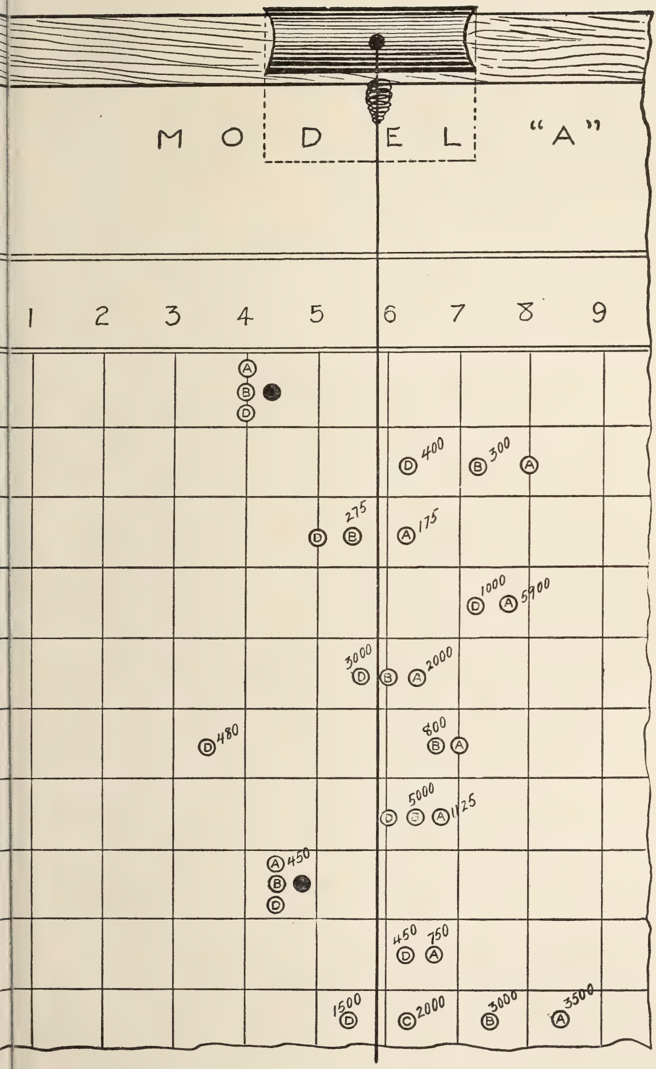
Using the Schedule Board

As indicated in the illustration, the schedule board shows the record for each part. In the first column, the part number is given. In the second, the name of the part may be writ-



Part No.	Part Name	Schedule	
		Per Wk	Per D.
100		1000	166
103		2000	333
108		500	83
111		7000	1167
112		5000	833
113		1000	166
118		2000	333
120		1000	166
125		1000	166
		6000	1000

A CORNER OF THE



E CHEDULE BOARD

ten. The third column shows the schedule per week, and the fourth the schedule per day—the number of each part that must be turned out weekly and daily if the production of all departments is to move along at an even rate. The figures shown in the third column are obtained by dividing the required output for the year by 52, the number of weeks; and the figures in the fourth column are obtained by dividing the number of working days per week into the weekly requirement.

Following the schedule columns "per week" and "per day" are fifty-two spaces, each representing one week of the year. As the board comes to the automatic-machine department, or any other operating department, for use, these spaces are blank. Upon them the department will keep its own record of output, and by comparing output week by week or day by day with the schedule in columns 3 and 4, it can tell how well it is keeping up.

The record of output is kept by means of small metal tacks, whose heads are lettered in accordance with the various operations. Thus

Ⓐ indicates first operation
Ⓑ indicates second operation
Ⓒ indicates third operation
Ⓓ indicates final operation, regardless of whether it is first, second, or third
● indicates job held up on account of lack of material.

An even more effective scheme of designating the operations is to use a different colored tack, instead of a different letter, for each operation. Thus red might indicate the first operation, white the second, blue the third, and green the final. But whatever the scheme used, the tacks are placed on the board to indicate how much of the output of each part has been processed through each operation. As work in the department progresses, and job tickets are turned in to report the completion of various parcels of work, the clerk in charge of the schedule board advances the tacks to represent the present standing of output.

How the Board Works

For example, let us assume that Part No. 103, Operation 2, has been finished to meet the schedule up to the fifth week. Since the weekly requirement is 2000, this means that 10,000 parts have been finished through this operation. A job ticket now comes through for 4300 parts, and Tack "B" is thereupon advanced to a position on the board just beyond the seventh line, since the production is 300 more than the production for seven weeks. (The figures written in by the side of the tacks indicate the production beyond what the line indicates.) Eight weeks' output of this part has been processed through the first operation, and 12,400 have passed through the final operations.

In Part No. 100 the record is not so encouraging. Four weeks' output, in this case 4000 parts, has been carried through all operations; but beyond that there has been no production of this part for the reason indicated by the black tack—lack of raw material. Of course this black tack becomes an immediate warning to the foreman, and the minute it appears on the board in any space he gets his requisition system working to obtain the necessary raw material.

An important feature of the schedule board is the wire indicator, which is moved forward each day to show just where production in all parts should stand on that day. By comparing the position of the tacks with the position of the wire, one can tell at a glance when production in any column is falling behind or pushing ahead.

A Picture of Production

Thus the schedule board is a graphic chart of the standing of production, itemized by parts and by operations. It is a picture of the factory's progress, or lack of progress, in any department. Not all factories require the degree of detail that the chart illustrated shows. Frequently it is necessary only to keep track of final operations.

Such a graphic record of production is not only a safeguard against overproduction or underproduction in any department, but it is also a factor in reducing costs. Under the old loose arrangements of former days, it was common to have men going through the departments to check up possible shortage or delay. The use of schedule boards reduces such use of stock-chasers to the minimum.

A good rule for interesting workers in "bogey" by means of charts and such devices is to set the standard low enough so that all can attain it. Although the copy books used to abjure us to "hitch our wagon to a star," it is poor policy to set such a high mark for workers that only the top-notch men can reach it. There is great satisfaction among a team of men when they have pushed the ball over the line, or the indicator over the mark. When this mark is set too high, they get discouraged and quit trying to reach it. Experience with schedule boards of this kind has shown that it is better to have the mark a little too low and give the crew the satisfaction of beating the mark than it is to have it too high.

Records used to keep production in step, like all other records, should be wisely used in the modern spirit of intelligent teamwork. The more workers that can be interested in such records, the greater success will they have in performing their function.

VIII

Controlling the Cost

THE same records that are used to keep track of assets, to prevent waste and dishonesty, to maintain efficiency of the working force and of equipment, and to keep production in step, are also the basic records from which the management obtains information about costs. From their data are made up the final records that enable the management to control costs.

The Cost System Is Built on Basic Records

Modern cost-finding systems are thus devised to fit in with and make use of the records already functioning in the factory. These original records do not themselves constitute a cost-finding system, as many manufacturers have found out to their surprise and sorrow. A set of records that keeps track of assets or of time is only the measuring instrument. It shows the amount of material used in producing a certain product, and the number of hours spent in the production, but it does not show the cost by the hour nor the cost of the job.

Of course it is possible to gather together the information contained in the basic records as to payroll, materials, and supplies, and the other expenses of production, add to these the salaries and general expenses, interest on investment and borrowed capital, taxes, insurance, and the like. By dividing the sum total of these items by the number of products made during the year we arrive at the cost of each unit of the product—say, each automobile, or each thousand pounds of refined sugar, or each sack of flour. This is actually what some manufacturers are doing today. But it doesn't give a very helpful story of costs. Suppose there are several types and styles of automobiles, or several grades of sugar, or several grades of flour—what then? Also, this method does not enable the production manager to control costs. Suppose it shows he is losing money? The end of the year is a pretty late date to find out this important fact. And if he is losing money, *where* is he losing it, and *why?* If he is making money, *where* is he making it, and *how?* If his market demands that he reduce the price of his product, *where* and *how* can he cut the cost?

An adequate cost-finding system will enable the management to answer these questions, not merely by departments, but by smaller subdivisions—even by individual machines and by processes. It might be so detailed in its analysis as to show on a card how much each man is producing. The cost accountant's function is to show up the efficiency of the plant in detail—to reveal where expenses are running up or falling down, where production is dropping or climbing, where costs are changing. With such knowledge before them, the production executives can supply the remedy without waiting for the balancing of the books at the end of the year.

Detailed Facts Necessary to Control of Costs

To enable the management to control costs, the records must show (1) the per-unit cost and (2) how that cost was incurred. With these facts in detail, the management can discover the why of costs and guide its future operations accordingly.

It should be remarked here that increased cost does not necessarily mean decreased efficiency, and decreased cost increased efficiency. Take the case of the weaving of fancy goods or colors in a textile mill. Differences in pattern and material cause costs to mount inevitably. In many industries the quality of raw material directly affects the cost barometer.

To be really efficient, the cost-finding system must be fitted to the needs of the industry it serves. Some systems attempt to force the industry into a strait-jacket of their own making, but they always fail. All good cost-finding systems get at the cost of each major operation performed in changing raw material into the finished product. It is not generally desirable to ascertain the cost of minor operations, because the expense of getting the information often exceeds any possible saving that might accrue. Should finer analysis of cost be desired, in order to ascertain whether or not the expense of some small operation can be reduced, this can be done by a special check-up of the operation covering a period of hours or days and an intensive study of ways of cheapening the operation. The cost system ordinarily does not strive to go that far, unless the small operation is exceedingly expensive or uses some precious or expensive material and therefore becomes a large part of the final cost of the manufactured article.

Minor Operations May Usually Be Ignored

The first requisite of a cost-finding system is an intelligent understanding of the processes of the industry and their relation to the finished product. Then there must be a common sense decision as to which processes it is desirable to have under immediate control through detailed cost figures. Such a decision will ordinarily affect the number and kind of job tickets given out, though for purposes of instructing workers there are sometimes job tickets given out for many operations that are lumped together in the final cost sheets.

In general there are three fairly distinct systems of ascertaining costs, varying according to the type of industrial activity whose costs are to be recorded. These are:

1. Special order system.
2. Standardized part system.
3. Process system.

The Special Order System

Under the SPECIAL ORDER SYSTEM all items of cost are charged directly to the order. This system may be used in ascertaining the manufacturing cost of locomotives, steamships, expensive jewelry, motor trucks, made-to-order furniture, books, printed material, and the like.

Assume that five motor trucks of a specified type are being put through the factory, either for stock or to meet a particular customer's order already received. A production order would be issued as explained in the preceding chapter. This order would bear an order number. As material is used, whether from the stores room or purchased expressly for this order, and as labor is applied, the costs are charged against this order number. These costs are accumulated from different sources. Material costs would be compiled from the numerous material requisitions or purchase requisitions, all of which show the number of the order to which the materials delivered are to be applied. Labor costs would be gathered from the time checks or job tickets of the workmen. Adding to these a proper proportion of the indirect expense gives the final manufacturing cost.

Standardized Part System

The STANDARDIZED PART SYSTEM provides for the application of all costs to the individual part entering into the completed article. In this system the charges are made against a part number rather than an order number. Take, for example, a watch factory in which more than five hundred operations are involved in making a watch. As is the case in many other factories, the workmen are specialized, one concentrating on one operation and doing nothing but that, while others specialize on other operations. Records are kept of the direct labor spent in each operation. Each part is given a "part number." There are standard operations for every part, numbered consecutively in the order of their performance. One workman, engaged in cutting a groove in a certain part of the watch mechanism, is given, let us say, 10,000 parts to put through this operation of grooving. When the work is given to him the timekeeper notes the time. It may take him four hours or eight hours or two days to groove the 10,000 parts, according to the difficulty of the operation; whatever the time required, it is noted by the timekeeper when the worker returns the grooved parts. Then it is a simple matter for the cost accountant to reckon the cost per hundred or per thousand for that operation, by dividing the number of parts into the total labor cost of putting the entire lot through the operation.

In a similar manner the lot passes from workman to workman until all the operations have been completed and each part becomes a finished part. The cost per hundred or per thousand for each operation is then a matter of record. The cost of materials is kept account of by a system of requisitions. Taking first the cost of the raw materials and adding the cost of all operations on a particular part, the result arrived at is the material and labor cost for that part.

In like manner two or more parts are brought together into what is known as an assembly. The cost of this assembly consists of the cost of the two single parts plus the cost of bringing them together. Minor assemblies find their way into larger ones, which in turn progress until the finished watch is reached.

Costs are built up in exactly the same way as the watch. When the watch is completed the cost is known.

Only where production is turned out in large quantities, and where the manufacturing is conducted on a schedule of standardized operations and parts, can this system be employed. Airplanes, guns, phonographs, typewriters, watches are products to which this system may be applied successfully. In this day of vast production, under methods of standardization of manufacturing, this system in all its refinements is of unlimited benefit in determining costs of every operation, every part, every assembly or combination of assemblies, terminating in the exact cost of the completed article. At the same time, it makes possible such comparisons with previous performances as to safeguard against excess of waste, scrap, defective parts, or other leaks.

The Process System

The PROCESS SYSTEM fixes costs on the process, rather than on the part or the order. It is adapted to special types of manufacturing, such as paint factories, canneries, bakeries, foundries, chemical plants, and the like. In the case of a baking plant, all costs for a particular dough would be charged to the process. The total cost of the entire product is thus obtained. The number of loaves made divided into the total cost gives the cost per loaf. In a foundry, all costs for a given period are applied to the product manufactured. Dividing the weight of completed castings into the total cost gives the cost per ton. Statistical figures may also be compiled showing the cost per ton for melted metal, labor cost, melting-department overhead, and overhead other than melting. Undue variations in the cost of the completed castings per ton may then be traced to their source.

The Systems in Combination

No factory uses either the special order system or the standardized part system solely. These systems, used without an analysis of cost into its elements by process, would involve the old fault of telling only *what* the cost of the completed article or part is, without telling *how* the cost was incurred. In connection with the special order system as applied to almost any article of manufacture, there is either an analysis of this cost into the cost of major operations kept along with the general cost and entered on the same set of records, or the cost of these operations is previously ascertained by a system of records over a period of time and is used as a basis for comparison of the total cost of the finished product with a set standard. Even in this case, variations from the standard cannot be traced unless there is a record to show the elements of cost. And so the special order system describes really a set of blanks as well as a system of cost-finding, and usually means that the blanks are designed to gather together all the elements of cost on any article manufactured to special order, on one sheet bearing the number of that order. Of course this is the simplest way to gather such facts for a special order, whether it be a job of letterheads turned out by a small printer or the construction of the Woolworth Building.

The standardized part system is also controlled by costs of various processes that are gone through with in the production of any part of a completed product. Take the tone arm of a phonograph, for example. The standard cost of this part is determined in advance by an analysis of the cost processes. This analysis enables the production manager to determine the cost of the raw material in the arm, and the cost of each process in its fabrication and assembling. If the process and the cost of raw materials remain the same, it is not necessary to repeat the task of ascertaining costs on each lot that goes through the factory, but simply to compare the total cost of these parts with the standard previously set. If this varies to a considerable extent, and the cause of the variation is obscure, another analysis will have to be made to determine it. But in the case of a small part requiring only a few operations, the cause of the variation is usually apparent by a little watchfulness which enables the executive to trace it to careless work, inefficient machines, waste of material, or some other easily discerned factor.

Cost Keeping Must Pay Its Own Way

Here, as always, the line is drawn at the point where the cost of keeping accurate records of each operation will be repaid in the possible economies to be effected in this operation. And it ought to be repeated again that each industry—and almost each factory—has its own special problems to be met by a cost-finding system adapted to its special needs.

So far we have been discussing methods of determining *where* cost was incurred. Let us consider the elements that enter into this cost, and the methods and records that enable us to keep track of these elements. Cost is usually divided into two major divisions:

1. Prime cost.
2. Overhead or burden.

Prime Cost

The prime cost is the cost of material and labor that enter directly into the manufacture of any article. These are kept track of by records that have already been explained—time or piecerate records for labor, and requisitions and job tickets and the like for material.

It will readily be recognized that these are not the only elements of cost, although some loose thinkers and loose talkers seem to think they are. Overhead, sometimes called "burden," is an important part of the cost. It consists of

Overhead

1. Indirect material, supplies, and the like.
2. Indirect labor.
3. Departmental expense.
4. General operating expense.

We have already discussed indirect material and supplies. The records that keep track of these items are gathered together in the cost department and apportioned to the product according to an arbitrary system, depending upon the material under consideration. Lubricating oil, for instance, is usually apportioned among machines according to the number of hours they were running. Cotton waste and other indirect materials and supplies are sometimes apportioned according to the number of parts manufactured or to the value of the parts, if they differ in value.

Indirect labor, such as the labor for scrubbing the factory floors or cleaning the windows, is usually apportioned among departments, either according to the time spent in such departments, or according to the relationships between the payrolls of the departments.

Departmental expense, foremen's salaries, clerical salaries, and the like, can easily be divided among the articles turned out by a department in a given period of time, either by number or value, according as the articles are identical or different in value. The same is true of general operating expenses. such as officials' salaries.

Making Each Part of Equipment Bear Its Share of Overhead

Other operating expenses such as rent, light, power, heat, and such items are sometimes distributed by being made a part of machine cost. Rent can be calculated by the square feet or cubic feet occupied by a machine or piece of apparatus, taxes by the assessed value of the machine, light and power by measuring or estimating the amount used in each department and by each machine and so on. The effort is to get all expenses definitely attached to equipment to make each part of the equipment bear its expense of overhead. Then it is possible to tell how much per hour it costs to maintain this equipment. In many industries, the effort of the cost system is to arrive at an hour cost for equipment. Then it is easy to make estimates, if we can arrive at the approximate number of hours each contemplated job will employ each piece of equipment, and it is easy to make comparisons when hour costs vary from week to week or month to month.

Labor Method or Machine-Rate Method

Sometimes the cost of the general expense is apportioned among the departments according to their payroll or the number of labor hours in each department. If all the operatives in each department get the same rate of pay, it can be apportioned according to payroll or labor *cost*. But if the operatives get different rates of pay because of a difference in operations and of other conditions, it is apportioned according to labor *hours* in each department.

The methods of distributing overhead by labor expended or by machine production are both good. The labor method is used, of course, where the operations are largely by hand and the machine-rate method is used where the operations are largely by machinery. The effort to determine the hour cost of all overhead expenses is the same in both cases. Knowing the production of workers or machines per hour enables us quickly to arrive at a basis for determining what share of overhead or burden each piece bears in each department.

Sometimes a factory does not keep an elaborate system of cost records, relying upon an estimating cost plan to keep control of costs. When it has the finished article in hand it will estimate the cost of material and the labor expended, add to this a fixed percentage for overhead, and the figure so computed will be accepted as the cost. Where material is the principal factor in costs, as is the case in the manufacture of jewelry, records of material cost may be kept, and the final cost determined by adding some given percentage to this to cover labor and overhead. Of course, such methods are loose and inadequate. And while a profit may be made on the total business of the year, it is likely that many of the articles are sold at a loss. Confronted by this situation, as profits become less and losses are in sight, the manufacturer will call in a cost accountant to verify the cost estimates. A simple system for doing this, known as *plan for verifying estimated costs,* has been devised.

The Estimating Cost Plan

To explain the plan let us take a small factory manufacturing raincoats. Four grades are made, the costs have been estimated as follows:

	Materials	Labor	Overhead	Total Estimated Cost
Grade A...	$6.00	$4.00	$2.00	$12.00
" B...	4.50	3.00	1.50	9.00
" C...	3.00	2.50	1.10	6.60
" D...	2.00	1.75	.75	4.50

The plan calls for a periodical testing of the accuracy of each element of cost as estimated, say every year or half-year. As a result of these tests, the schedule is revised from time to time so that the estimates for the following period may be more nearly correct.

In order to make the tests, separate material accounts are kept for each grade, each being charged with the particular material bought for that grade of raincoat. Likewise the labor spent on each grade is kept record of. At the end of the year it is possible to determine just how much has actually been expended for material and labor on each grade. Dividing these figures by the quantity produced, the correct material and labor cost for each is found. To complete the verification it is then necessary to determine what rate of overhead must be added to equal the actual indirect expenses incurred during the year.

The usefulness of a plan of this kind is very limited. A year, or even six months, is a long time to wait to determine whether operations are being conducted on a profitable or losing basis. And conditions during the year may change entirely, so gradually perhaps that they are scarcely noticed at the time, yet so considerable in their accumulation as to render the estimate worthless. And of course such a plan is very inadequate as a means of testing the efficiency of the workmen or the management; no detail records are maintained through which comparisons with standards or past performances may be made.

Itemized Costs Most Valuable

The final result of all good cost-finding systems is a tabulated sheet or set of records showing the cost per unit of each part or operation or material (direct or indirect) that enters into the finished product. These figures furnish an immediate danger signal when something is wrong. In the lumber industry, for instance, the records show how much each item costs per thousand board feet of lumber. Suppose the figures record that twice as much lubricating grease per thousand feet was used in the planing mill this month as was used last month. This is a signal that the grease is being wasted or stolen, and an investigation is set on foot at once. Many times these final cost figures, by furnishing a quick method of comparison, disclose inefficiency or dishonesty where the requisitions themselves failed to do so, because in the case of the requisitions, there was no quick way to compare amounts of indirect materials withdrawn from the stores room with amounts previously withdrawn.

The greatest value of a cost system is its ability to furnish columns of figures that enable us quickly to compare costs of operations and materials with former costs and to keep them always at a standard. Timeliness is therefore an essential feature of the making of such final comparative sheets and all systems should be devised so that they can be analyzed quickly and made use of before the information they give us is too stale to aid in controlling costs.

Timeliness an Essential Feature

This chapter has not pretended to go into the various methods or theories of cost accounting. It is a specialized branch of the science of accounting and has been carried to a point of high perfection. Volumes and whole libraries have been written about it and disputed points and theories.

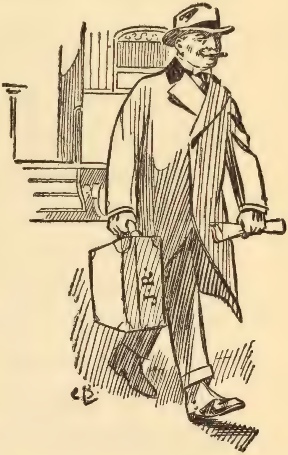
The active production executive will make an effort to use the cost system he finds in his plant and to avail himself of the information it contains to enable him to keep costs to standard. He will make an effort to understand all the forms with which he comes in contact, see that they are accurately filled in, and make such a system one of his aids in controlling the cost of every operation for which he is responsible.

IX

Records as a Tool of Production

JOHN ROSWELL, president and principal owner of the Roswell Manufacturing Company, returned from his trip East in high spirits. And no wonder. For he brought back the fruits of victory. He had gone after a certain contract, in a territory that was absolutely new to him; and in competition with a dozen rivals, every one of them a well-known manufacturer in his line, he had got the contract. As the treasurer said, congratulating him, "It was a killing."

"Well," explained the president, "it was our prices that did it. We've simply got the jump on these other factories, somehow. I didn't cut down a single figure. I didn't change any of the estimates we agreed



John Roswell returned in high spirits

on here in the office before I left. I didn't have to. Our quotations were a good margin below even those big New England fellows whom we feared most. And this is the result." Roswell took the written contract from his pocket and handed it to the treasurer.

Outbidding Competitors

The order was a fairly large one, and a good profit had been figured on it. But it was not so much the size of the business, as the fact that it was new business, that caused elation. Heretofore the Roswell Company had taken on only an occasional special contract. Its manufacturing was principally manufacturing for stock and it confined its selling activities largely to the Mid-Western territory in which it was located. As a matter of fact, Roswell products were so well known and highly esteemed in that section, that rival manufacturers found it almost impossible to make much headway against them. But now the Roswell Company had decided to go into outside territory, and extend its business beyond the limits of its own section. The opportunity to bid on a job for an Eastern buyer had come, and had been grasped as a chance to break into the national field. Conferences with the various production foremen had been held, estimates had been made, prices had been agreed upon, and armed with these figures the president had made his trip East—with results as reported.

The order was turned over to the production departments of the company, and during the next four months John Roswell made more trips and came back with more orders. Business was booming. Production was coming along swimmingly, according to oral reports from the various foremen. But the contract on that Eastern order called for delivery within six months, and as only two months remained, Roswell decided one day to go through the plant and personally check up its progress.

Letting an Order Take Care of Itself

It was good that he did, though what he discovered made his heart sick. He found that far from being in "apple-pie order," as Jim, the foreman of one of the departments, had reported to him only that morning, the job was in a horrible mess. Jim's part of it, to be sure, was in apple-pie order; the production through his department was right up to the schedule that Jim had set for himself. But in another department the production was far behind; and when the situation was called to the attention of the foreman there, it was discovered that his men had been switched to another job because certain raw materials needed for the prior job had not been received.

This carried the investigation to the stores department, and there it was found that the stores clerk had mistakenly given out for another job material which was supposed to be reserved for this one.

By dint of much telegraphing and the shipment of material at costly express rates, the shortage was made good within a few days. And by concentrating all needed forces on the delayed job, its production was shoved through so that delivery was made on the last day of the six months allowed by the contract. Of course the speeding-up process was expensive, and money was lost on the job where profits had been expected. But the reputation of the company was saved. Moreover, as Roswell some months later remarked, "that little set-to was a valuable lesson and worth all that it cost."

A Failure of Records

It taught the Roswell Manufacturing Company the importance of adequate records. The failure of the stores clerk was due to the failure of his records to show what materials were to be reserved for each job, and how much, and when they would be needed. As a matter of fact, the stores clerk had largely depended on his memory to keep tab on these things. It had been a point with Roswell "to waste as little time as possible on paper." Card systems and files and "all such truck" had been only tolerated. Where used at all, they were regarded as necessary evils, and employed as little as possible. Not only the stores, but other departments as well, reflected this attitude of the president.

But the costly experience with that special order—that contract which had been hailed as the beginning of big things—woke Roswell up, and he decided to give his business a thorough inspection. He had always been scrupulously careful of equipment; machinery in his plant was subjected to regular inspection, and repairs were made promptly. But the inspection which he now proposed was to be of a different kind. It was to be an investigation of methods, rather than of equipment; and in order to make it as unbiased and as thorough as possible, he decided to call in an outsider.

Calling In the Business Doctor

This outsider, an expert production engineer and systematizer, came into the offices and plant of the Roswell Manufacturing Company in much the same way that a doctor goes into a sick room. He was called in to diagnose the case and prescribe a remedy. John Roswell gave him the run of the place. All the books were turned over to the investigator, and he spent several days analyzing them. Then he spent another week in the plant, visiting the various departments, studying the methods employed in carrying through the production, in keeping account of material, of labor, and of other costs, and of caring for the finished stock.

The results of this investigation were summed up in a written report in which the investigator showed these startling facts:

Losses Due to Lack of Records

1. The cost figures upon which the bid for the Eastern contract had been based, were inaccurate. The foremen had no exact records of production costs, and as a result their estimates were little more than guesses. It was shown that even had there been no extra expense caused by the shortage of material, the company would have lost money on the contract.

2. There was no system for reporting the progress of work through the plant, and as a result some departments were frequently overcrowded with work while others were running light. Consequently there was considerable loss in idle machinery and labor, as well as in power and other overhead.

3. Material used was far in excess of what the output warranted. This was accounted for by loose checking of raw material as delivered, by wasteful issuance of material from stores, and by spoilage of work in process.

There were no records to show up these leaks as they occurred.

It may seem incredible to a modern factory man that a plant could be operating for years, apparently successfully, with such loose control of the elements entering into cost. But the case is an actual one, though of course the names are camouflaged. The advantage of an early start and an exclusive sales territory had made the business profitable in spite of these heavy drains upon it. Production moved along through the factory largely of its own momentum. Goods were turned out for stock and then were sold at such prices as conditions seemed to justify. It took the big special order, with its race against time, to show how inefficient and wasteful the business really was.

The sequel to this story can be told in a few words. With the proof of lost profits before him, John Roswell realized that adequate records were themselves a tool of production. He would never have disputed the value of records in keeping tabs on inquiries from customers, in collecting bills for goods sold, and in accounting for the company's finances. Now he learned that records could be used to facilitate production, as well as to facilitate sales, collections, and financing, and he lost no time in installing and using this valuable aid. Today he knows exactly where his money goes, his prices are based on actual costs and not guesswork, and his production and deliveries are scheduled with as much care and almost as little error as the course of the Twentieth Century Limited from Chicago to New York.

John Roswell's old attitude toward factory records is not an exceptional one. All through industry, in high places and in low, you will find some men who have a tendency to belittle the importance of records and to regard them as unnecessary red-tape. This attitude is responsible for the shipshod way in which many workers and foremen alike fill in requisitions. An applicant for work at a government employment office was asked why he left his former job. He replied, "Because it's a hell of a place to work. They make you fill out a requisition every time you want a drink of water." This was not true, of course, but the exaggeration indicated the typical impatience of the average worker toward record systems in general.

Records for Their Own Sake

The opposite tendency, often found among accountants who give their whole lives to figures, is to become fascinated by the fine points of their systems and to think of these as an end in themselves, instead of merely as a means. This extreme attitude is responsible for the elaborate pink-

and-green-and-blue card systems with which some industrial plants were cluttered up a few years ago, when paper and ink were cheap. Like the woodsman who spent his life among the trees and had never climbed onto the neighboring mountaintop to see the entire forest, such experts fail to see the purpose and practical value of the whole system because they are engrossed with its mere details.

Both of these extreme attitudes are wrong, of course. Good production records, as has been shown in this Unit, are neither "ornamental trimmings" nor "the whole cheese." A record system exists, and has its only excuse for existing, as a servant of industry. The purpose of every industrial plant is to produce goods at a profit. A record system that will aid in the accomplishment of this purpose is a good tool of production. If the system does not aid, it is a poor tool, no matter how expertly-devised or beautifully-arranged it may be from the standpoint of the accounting specialist.

When a Record Was Unnecessary

A certain machine shop in Massachusetts, which had a very careful planning department, and a complete system of job tickets and other controlling records, adopted the plan of attaching a special tag to the job ticket for work that was to be rushed. The special tags were printed on yellow paper, so as to attract attention, and the word RUSH was printed on them in big black letters. The scheme worked well, so far as attracting the attention of the foremen and causing them to put the rush jobs through in quick time. But when the planning department came to check up its schedules, it found that the other jobs—those that had not been marked Rush—were sadly behind, and all askew so far as their scheduled arrangement was concerned. Every job ticket, including those of the rush jobs, was plainly marked as to dates wanted, and the dates were supposed to govern the order in which the work was done. But after obeying the call of the yellow tags, the foremen seemed to think that they were relieved of all conformity to dates or schedules, and took up the other jobs in whatever order they pleased.

In that shop today there are no yellow slips. Rush work is not distinguished by any particular badge other than the date entered on its job ticket. And since all job tickets have their scheduled dates, and the foremen are instructed to pay strict attention to the job tickets and be guided by them alone, the result is that rush work gets out just as quickly as it did under the old system, and the other work is not neglected nor thrown out of order in the process. In other words, it was realized by the management that the yellow slips were not necessary, and in fact were a hindrance to some of the work. All the necessary information was already contained on the job tickets. So the yellow tags were discarded as a poor tool.

The Test of Good Records

To be a good tool of production a record must be necessary, and then it must conform to those four requirements of good records listed in Chapter II. It must be accurate, simple, timely, adequate. Every foreman, every superintendent, every plant executive in whatever capacity who has to make and use records, ought to be continually on the alert to improve the records, to make them still better and more efficient, still more effective as a tool of production. He can do this by testing all existing records, and all proposed new ones, by these simple questions:

Is it necessary?
Is it accurate?
Is it simple?
Is it timely?
Is it adequate for the purpose required?

Production executives will find the planning department and the accounting department fully alive to the importance of their cooperation. After all, these two departments are themselves in a sense only tools to aid the production man in getting out his production. Close cooperation, based on a better understanding of the records used by the two departments, will greatly aid the teamwork without which industry cannot be truly efficient.

Records That the Foreman May Keep

The foreman who learns by experience the value of records in the production plant will find that there are records he can keep and use to advantage—records quite apart from the general system installed in the plant. Such records are those made in the foreman's personal note-book, in which he keeps notes of his men as a basis for discipline, wage or rate increases, and promotion. Included also in such records are those that have to do with the foreman's personal experience and observation of the processes, equipment, and methods in his department and in the plant as a whole. Records of this kind often reveal interesting comparisons, and point the way to improvements.

The foreman of the finishing room of a Grand Rapids furniture factory found that by installing a set of experiment cards, the time required to mix stains was cut almost to a fourth. Formerly the mixing of colors was accomplished by "taking a little of this, and a little of that." Now all such quantities are measured and recorded, and a sample of wood stained with the mixture is filed away with the record of the formula. And it was a foreman's informal records, and his own alertness and initiative in suggesting the method, that changed this process from one of guesswork to one of accurate knowledge.

Records are tools. But they are serviceable only if used. And they can be used with greatest success only when the user understands them thoroughly, and believes in them. Know your plant record system, get acquainted with it and with the details of its records, test them by the suggested test for good records. Then you will be able to make the most of these necessary tools of production, and will find yourself a better team member, a better team leader—a stronger man on your job.

QUIZ QUESTIONS

I

1. What convinced Pitkin that he had been neglecting money-making opportunities?

2. How may records be used to appeal to the spirit of rivalry and spur up production?

3. Why is it poor business to depend on memory for keeping account of important industrial data?

4. How do records assist in planning operations?

II

5. Name four basic requirements of good records.

6. What is the difference between statistical and financial records? With which of these two classes of records is the production man chiefly interested?

7. How can one determine what records are necessary for a particular plant or department?

8. Name six functions in which records should aid the production man.

III

9. What two functions must labor records perform?

10. What is meant by "one-man hours"?

11. How does the time element affect output and costs?

12. Explain the following systems of keeping record of the arrival and departure of employees: (*a*) The check system; (*b*) The clock system.

13. Explain three methods of keeping record of the time spent on a job.

14. What is a job ticket? What does it record? Name three functions performed by job tickets.

IV

15. What is the difference between "liquid" assets and "fixed" assets?

16. What is a balance of stores sheet? What does it keep account of?

17. What is a stores issue? Who may draw it up? How does it safeguard material?

18. Explain a method of checking stores to verify the records.

19. What is the Mnemonic system? Name another system of symbols in use.

20. Why should output be checked against material?

21. Explain a system of budgeting the material.

22. What is work-in-process, and what record is used to keep account of it?

23. What is the advantage of using spoiled-work-tickets?

24. How is the interdepartmental shipping ticket used?

V

25. What is depreciation, and how does it affect "fixed" assets?

26. Name four causes of depreciation.

27. Explain the investment ledger system.

28. Why is depreciation considered an operating expense?

29. Why should there be records of the position of the machinery?

VI

30. What four items of information does the man in charge want to know about his equipment?

31. When a mechanical counter or weigher cannot be used, what other means are there of keeping records of the output?

32. Explain how machine efficiency may be increased by the use of records that appeal to the interest of the workers.

33. How do records assist in (*a*) increasing the speed of mechanical operations, (*b*) controlling chemical processes, (*c*) reducing repairs?

34. How does the idle machine tag help in decreasing machine idleness?

35. How do equipment records guide the management in making improvements in design?

VII

36. Why does the good production manager strive for rapid turnover?

37. What is the planning department and its function?

38. What is a production order? Who issues it? What is its purpose?

39. How is the job ticket related to the production order?

40. What is a piecework rate card, and what service does it render?

41. What is a job instructor? How does it help production?

42. What is a shop order?

43. What two things must the executive know in order to keep production up to schedule?

44. Explain the purpose, method of use, and results gained from the schedule board described in the chapter.

VIII

45. Why is detailed analysis of basic records necessary to a good cost-finding system?

46. Explain (*a*) the special order system, (*b*) the standardized part system, (*c*) how these systems are used in combination.

47. What is meant by prime cost? What elements does it include?

48. What is overhead, or burden? Name four elements that enter into it.

49. Explain the two methods, labor method and machine-rate method, of apportioning overhead.

50. What is the estimating cost plan? What are its defects?

51. Why should cost figures be (*a*) comparative and (*b*) timely?

IX

52. What extreme attitude toward records is often found among production men? What is the opposite extreme often occupied by accounting experts? Explain why each of these extremes is wrong.

53. What is the test of good records?

54. Why should the foreman keep records on his own account?

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